Engineering Record

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Federation of Planning Boards

LAST YEAR there was formed in Massachusetts an organization that should prove of great benefit to the towns and cities of the state. It is known as the Massachusetts Federation of Planning Boards, and its function is to help the town-planning bodies of the individual communities. It has now started to put forth a series of bulletins which aim to stimulate the local boards to greater activity and efficiency. The federation is seeking to discover conditions which hamper the effectiveness of the local boards. As these conditions are disclosed it is proposed to formulate additional legislation which will enable the town-planning work of the state to reach the maximum effectiveness. The personnel of the executive board of the federation is such as to guarantee the success of the efforts. Other states could well profit by following the Massachusetts lead, not only as to the fundamental town-planning act but in the organization of a state federation of planning boards.

Barge-Canal Operation

WITH the early completion of the New York State Barge Canal in sight, as explained in the leading article in this issue, new problems present themselves for solution. Construction work is now about 90 per cent finished, and in fact several sections of the various routes have been open for navigation during the past year. It is apparent therefore that the thoughts of barge-canal officials are now being diverted from the well-worn channels of construction to the newer ones of operation and maintenance. The improved waterway linking the Great Lakes with tidewater at New York harbor represents an investment of something like $155,000,000. How is this great sum to be made to pay dividends? What is needed first is a business-getting agency—some bureau whose function would be to disseminate information concerning the advantages, facilities and other features relating to the barge-canal system. Facts of this sort should be of immediate interest to merchants, manufacturers, shippers and others, not only of New York State but of other sections of the country indirectly served by the barge canal. With these ideas in mind, State Engineer Williams has proposed the creation of a traffic bureau. It is only by means of such a bureau that the full benefit of the canal can be quickly realized when construction is completed. In spite of the fact that New York State has spent a vast sum of money on this project, the people, as a whole, have very hazy notions regarding it. It is time now to begin a campaign exploiting the value of the canal as a freight-shipping medium. Certainly a private corporation in charge of a public utility, almost completed, would have its agents in the field soliciting business. As a matter of fact, a number of interesting traffic developments, involving the use of the barge canal by large private interests, are already in the formative stage. Without doubt others will soon follow. Everything points to the need of a traffic bureau such as Mr. Williams has proposed, and there should be no delay in its organization.

Help from the Outside

THE TRUTH is out. A clear-visioned attorney at law from a hamlet in Minnesota has seen through the "smoke" raised by the Engineering Record in accounting for the Quebec Bridge accident—through both the "voluminous language" published by this journal regarding castings and a futile attempt by private letter to justify its position. One look at the photograph of the falling span showed the attorney at law that "all there was to it was that the span was not strong enough to support itself, and that it, therefore, broke down and fell into the river." In the letter referred to, the Engineering Record had tried to say that the crumpling of the span took place only after the failure of the casting, when the trusses had been subjected to stresses for which they had never been designed. But the learned counsel pointed out that "the span was 640 ft. long and of good, liberal width," and that any margin of safety that would not stand a settling of 4 ft. at one corner—one foot in 160 or one inch in 13 ft.—"must have been calculated with parsimonious frugality." And as a clincher he noted that the trusses "crumpled up something like 540 ft. from where your imagination leads you to suggest that the casting failed." On only one other point the Engineering Record would seek enlightenment: What had the "good, liberal width" to do with it?

Engineering Harpies

ALL PROFESSIONS are preyed upon by unscrupulous individuals who use their knowledge of some phase of the technique to make the lure plausible. The swindlers who have given engineers positions in questionable promotion companies but insisted on their investing $500 or $1,000 have not been heard from for some little time. It is to be hoped that the Federal authorities can keep them sufficiently under surveillance to prevent further operations. About a year ago a number of railroad and construction engineers in Chicago deposited money for expenses with W. D. Middaugh, a supposed agent of the Norton-Griffiths Company of London, which, it was asserted, had a contract to build the Wallaroo, Moonta & Northern Railway in Australia. Horace Nugent, the local British consul, has recently made public the results of an investigation which indicate that the contracting firm never heard of Middaugh and that there is no such railway in Australia as the Wallaroo, Moonta & Northern Railway Company. It is the practice of one of the newer engineering societies in Chicago to investigate such schemes as soon as suspicion points to them. Many engineers have thus been saved money they could ill afford to lose. More work of this kind could be done by engineering societies with profit to the profession as a whole. It is surprising to learn how little watching is necessary to make the "sucker business" unprofitable.

Adopt the Budget Principle

IN last week's issue of the Engineering Record, page 488, criticism was directed at the overloaded convention program of the American Society of Municipal Improvements at Newark, N. J. The session on sewage treatment was particularly disappointing, due primarily to mismanagement in allotting insufficient time to this prominent feature of the program. Several excellent papers were omitted entirely, others had to be condensed to a point where their full effect was lost and, most unfortunate of all, no discussion was possible on the afternoon the papers were delivered, in spite of the fact that an unusually large number of prominent sanitary engineers had journeyed to the meeting for the specific purpose of asking questions and making comments from the floor. The case illustrates forcibly the necessity of applying to convention-program arrangements the methods commonly followed in budget-making. In other words, let there be made, beforehand, a fairly definite mold by which the convention proceedings may be shaped. There is nothing complex about this scheme. It is a simple matter to learn, in advance, how much time is available at each session. By determining the length of the various papers to be delivered it is also possible to estimate accurately how many minutes the reading of each one will consume. If papers are not received in advance, a definite time limit should be placed upon them, depending on their importance. Then let some man with an appreciation of relative values make up a program which can be rigidly followed. The right kind of man will quickly sense the big things and give to them the prominence they deserve. He should also be able to make a very shrewd estimate as to a proper allowance of time for discussion. In fact, individual discussion might have a definite time limit put upon it, so as to give everyone with anything to say an opportunity of being heard.

Efficient convention management really resolves itself into nothing more than intelligent advance planning. Foresight of this sort was entirely lacking at the recent Municipal Improvements convention in Newark. In the fiasco of the sewage-treatment session there is an important lesson for other engineering organizations which hold conventions. It is not enough merely to secure a number of good technical papers and a number of good technical men to discuss them. The engineering society's responsibility goes farther than this. It must insure for authors and auditors alike fair treatment. If present practice is followed much longer, it will soon be difficult to convince engineers that it is worth while to prepare papers for engineering conventions.

Creditable Work of the California Highway Commission

IN the past seven years California has expended $18,000,000 on highways. How great an asset this expenditure has produced and how greatly it has improved the future prospects of the state can be realized only by those who have seen something of the splendid highway system that has been built. Among engineers the California highway system has become well known because of the great mileage of oiled-surface concrete pavement, constructed with very limited funds. The chief reason for the notable success is that engineering ability and efficient management have gone hand in hand in carrying on the work. Furthermore, the commission has been notably free from political influence, and complex questions in the choice of routes have been settled with a fairmindedness that has won the people's confidence.

The act which provided the first state funds for the work stated that "the highways constructed or acquired under the provision of this act shall be permanent in character . . ." And thus the commission undertook its work with an impossible assignment before it. The concrete-base highways have proved a success and the maintenance charges have been very low. Nevertheless, maintenance must be provided for, and it is to be remembered that there will be a very considerable mileage of the completed system which will not be hard surfaced and on which there must be a generous allowance for repair and upkeep.

The commission has built up an organization which the state highway engineer controls as chief executive. Judging it solely by results, it is one of the most effective in the country. It is therefore important that its integrity should be preserved.

There is much work to be done. Long gaps must be filled before the greatest benefits of the trunk-route system can be realized. The state is about to vote on a proposed $15,000,000 bond issue, of which $12,000,000 would be used to fill in these gaps and $3,000,000 would be applied (on a county-aid co-operative basis) to the building of eight additional highways or extensions of the original system, the desirability of which has become apparent in the past two or three years. It is not conceivable that there could be anything but a hearty approval of this issue, especially since California has available such an efficient road-building organization.

Change in New York's Subway Personnel

AMONG the friends of Alfred Craven the announcement, in the news columns of this issue, of his retirement as chief engineer of the New York Public Service Commission, which is building the city's new subway system, will cause deep and widespread regret. It is true that Mr. Craven is not a young man, as young men are judged in these days—he celebrated his seventieth birthday last month. Nevertheless, the completion of the new subway system is only a year or so away, and those who have followed him in his arduous task of directing the country's biggest engineering job cannot help wishing that the pilot who had steered the course of the commission's engineering work thus far could have brought his ship safely into port. Mr. Craven felt, however, that the time had come to surrender the wheel to other hands. He remains with the commission as consulting engineer.

This is the situation so far as Mr. Craven is concerned. Now comes the question as to his successor. When a change of personnel involving large engineering responsibilities and, incidentally, a salary of $20,000 is made, it is natural to expect from the appointing power—in this case the New York Public Service Commission—a rather complete statement of the facts in the case. Otherwise suspicion is aroused, particularly since the commission was once before under fire in connection with the retirement of its chief engineer.

The brief statement of Mr. Craven's retirement in the New York daily papers last week was accompanied by the announcement that Daniel L. Turner, deputy engineer of subway construction, had been named acting chief engineer. No mention whatever was made of Robert Ridgway, engineer of subway construction, second in command to the chief engineer, and, in the regular course of promotion, the logical successor to the position left vacant by Mr. Craven's retirement. What does the Public Service Commission mean by a tactless announcement of this sort? Is the engineering profession to infer that the logical successor to the office of chief engineer of the country's largest construction project has been deliberately passed by in favor of his former subordinate—with no reason given for such action—or is it to assume that the post of chief engineer may still be considered as open and that the man to fill it ultimately is the one who for years past, in Mr. Craven's absence, has been officially designated as acting chief engineer? These are pertinent questions. In justice to the men concerned and to the profession at large, which stands squarely upon a platform of promotion by merit, they should be answered.

Actions of this sort, unaccompanied by explanations, inevitably result in disrupting the efficiency of any organization. A comparison of the professional records of the present engineer of subway construction and his deputy—the newly appointed acting chief engineer—gives no clue as to the reasons for the commission's action. Among his fellow-engineers Mr. Ridgway enjoys an enviable reputation both as a construction man and as an engineering executive of large capacity. His steady rise in responsibility on work of the old Aqueduct Commission, on the Rapid Transit Commission, which built the present subway system, on the Catskill Aqueduct, where he occupied the important post of department engineer, and on the Public Service Commission, where, as engineer of subway construction, he has been second in command to the chief engineer, is a definite tribute to his worth. In fact, when the city of Chicago wanted advice on the solution of its rapid-transit problem recently it selected Robert Ridgway as one member of its advisory commission—the other two members being men of such national prominence as William Barclay Parsons and Bion J. Arnold. And yet the Public Service Commission, from all outward signs, at least, has passed him by in filling the chief executive position in its engineering department.

A man of Mr. Ridgway's standing cannot be disregarded, as would a minor subordinate, without full explanation. The position of chief engineer is still vacant. Does the commission intend to appoint to this post the man who is the logical candidate for it? If not, why not?

Women's Vote and the Engineer

UNLESS the Women's City Club of Chicago were assured that the expenditure of a proposed $2,000,000 bond issue for increasing the garbage-disposal facilities of the city would be placed in the hands of competent engineers, the members were determined to oppose it. Mary McDowell was spokeswoman of the club, and when Miss McDowell is against a measure in Chicago, even case-hardened politicians pay attention. The following quotation from Miss McDowell's statement indicates what the entry of women into politics may mean to the engineer:

"We will not stand for a bond issue unless there is a competent engineering expert at the head of the waste bureau. The disposal of garbage and other waste is a matter of sanitation, and for sanitation we need an engineer. We will not stand for putting the disposal of the city's wastes into politics. Under such conditions we will go out and do our utmost to defeat the bond issue when submitted to the voters. If there is a competent engineering expert at the head of the bureau, we will support the issue. We will go out and speak for it and do all we can. But we won't stand for putting the disposal of wastes into politics."

The aldermen apparently saw the futility of attempting to oppose the women. The efficiency staff was instructed to formulate a program with the proposed issue halved, while the commissioner of public works promised to comply with the women's request as to the engineering appointment.

There seems to be no reason why local engineering societies should not also take a hand in such a proceeding. If Miss McDowell and nine other women can lop off $1,000,000 at least temporarily (for the $2,000,000 issue was finally agreed upon) from a proposed bond issue unless engineers are put in charge of the work, the engineers ought to be somewhat more than slightly interested.

Heartwood Specification Needed to Get Best-Grade Timber

THE lack of a heart specification in the Southern Pine Association's select structural grade of timber has given a certain false sense of security to those engineers who have not looked into the specifications carefully and who do not know exactly what they may expect to get. When the word "longleaf" was eliminated from the specification of the American Railway Association the clauses covering different conditions with 75 to 85 per cent heart were still retained, so that the specification was not emasculated, and, with the exception of a very small percentage, longleaf timber only could qualify. Close-grained sapwood, it is generally admitted, may have the same strength as heartwood, but few persons contend that it has the same durability (see the Engineering Record of Aug. 29, 1914, page 255). Hence, to get the highest grade of material, which the engineer believes he is asking for, a heartwood clause should be included in the select structural grade specification, which already takes care of density or the strength factor.

Timbers cut from good longleaf and grading up to the select structural specification are bound to show 80 per cent or more heart. The timber grows that way and the longleaf manufacturer is forced to furnish heart timbers whether the buyer is paying extra for them or not. Consequently it is apparent that if the botanical distinction is to be avoided, a heart specification must be added to the select structural grade if that grade is to continue to pose as the highest grade of Southern pine timber.

The Southern Pine Association has made great progress in defining grades, but there is still room for improvement. The American Society for Testing Materials is the sponsor for the select structural grade, and that body is the one to improve the specification if further confusion is to be avoided. As it now stands the specifications of this organization ignore the important difference between longleaf and the two other principal Southern pines. Longleaf is distinguished for its lack of sapwood to as marked a degree as the others are distinguished for the abundance of it.

More and more engineers and architects must study the conditions under which the various grades are to be used. Where strength without long life is the desideratum, shortleaf, which has the strength, should be used, conserving the higher type for those uses where durability, as well as strength, is essential.

How Shall Motor Trucks Be Regulated to Conserve Highways?

AS a measure of protection for its highways the State of New Jersey is planning legislation to control the weight, size and speed of commercial motor vehicles. The initial stage in this movement was reached recently when a special committee, appointed by William L. Dill, state commissioner of motor vehicles, submitted a tentative draft of rules and regulations, which is given on page 536. It is to be noted that these requirements are not final. Further hearings are scheduled in order to secure the benefit of a full discussion of their merits or defects before adoption. Present indications are that a number of changes will be made.

The New Jersey situation is one of more than local interest. The signs are unmistakable that it will soon be faced in most of the states. Into the solution of this problem enter two of the greatest factors of public welfare—good roads and transportation—both involving millions in past investments and millions more in future expenditures. Upon what common ground of understanding can the road builder and the motor truck manufacturer and operator work to best advantage? We must have good roads, we must have motor trucks; this our legislators must keep in mind. To attempt to rule the truck off the road by drastic restrictions would be as futile as to demand from engineers unduly expensive types of road construction for carrying any kind of unreasonable traffic which the whim of truck designers might impose upon them.

The menace of hasty, ill-considered legislation on this question is so serious that bodies with law-making functions and highway engineers called in in an advisory capacity should weigh carefully all arguments before final action is taken. The value of such procedure is well illustrated in the case of New Jersey's proposed rules. The motor-truck interests have raised serious objections to legislation embodying these requirements. Many of these protests appear to be well founded. Others are obviously colored by partisan judgment. Nevertheless, they should prove useful to highway engineers.

The case of the motor-truck manufacturers, as developed by members of the Motor Truck Club of America and their attorney, Charles G. Bond, at a meeting in New York last week can be summarized as follows:

Sections 2 and 8 of the proposed rules (see page 536) prohibit the use of metal tires on both trucks and trailers. In the case of the trailers this restriction is held to be unjust. Trailer wheels merely roll over the road—there is no tractive effort applied, as in the case of the drive-wheels of a truck. Operated at suitably low speed and with the weight distributed by a broad tire, it is held that steel-tired trailers would produce no unreasonable wear on the road surface. If the trailer must be equipped with rubber tires, the motor truck men say, why should not the same restriction be applied to horse-drawn vehicles?

In the case of Section 5, calling for sealed governors on trucks to limit speed, a very interesting situation develops. Electric trucks, it was argued, are never equipped with governors. The passage of a bill calling for them, therefore, would exclude electric trucks from the state roads. Surely no such result was in the minds of the committee when this clause of the report was drafted. As for the gasoline-driven trucks, some are built with governors and some without. Section 5, if passed, would consequently necessitate radical changes in motor design on the part of some manufacturers, or else would stop the sale of their products in New Jersey. On the governor question the motor-truck men themselves are decidedly at variance. One member, for example, said: "The state of the industry has not produced a governor which will stand up under motor-truck service." It was further advanced against the governor that it would prevent a truck when light from operating at a higher speed than when loaded. On return trips, running light, every truck would lose valuable time.

Moreover, the rules take no cognizance of the character of the roads in limiting motor-truck speeds and weights. Should the same restrictions hold for water-bound macadam as for grouted granite block?

Exception was also taken to Section 7, limiting the overall length of trucks to 23 ft. 6 in. It developed that one of the large motor-truck manufacturers is producing a standard vehicle somewhat longer than 26 ft. Its function is to carry light, but bulky loads. No serious road damage could be expected from a motor vehicle thus used, but the New Jersey rules, in their present form, make no exception to the 23-ft. 6-in. length.

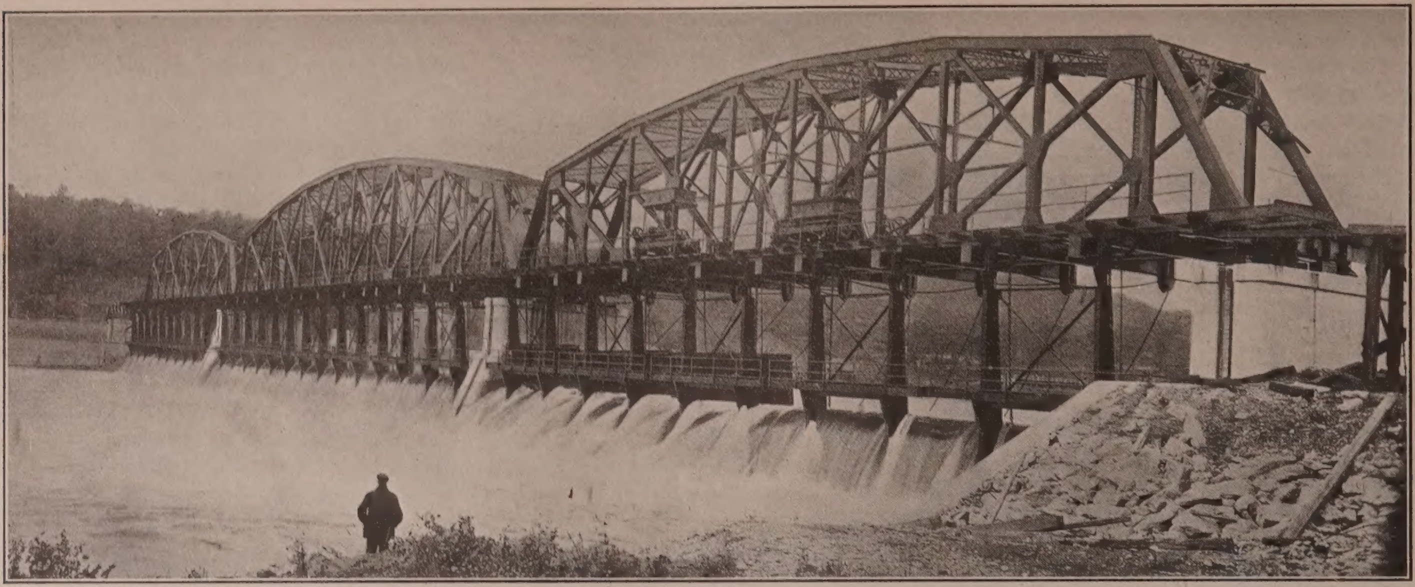
Opposition developed also to Section 8, allowing only one trailer per truck. The argument was advanced that a string of trailers, instead of increasing traffic congestion, would actually decrease it by reducing the spacing between vehicles. The proposed limitation to one trailer apparently was conceived with operation around curves in mind.

The table of limiting wheel loadings and speeds was ultra-conservative, in the opinion of the motor-truck men. In Massachusetts an 800-lb. load per inch of tire width is allowed, and the opinion was expressed that 1000 lb. per inch should not be considered excessive.

There was some debate regarding the question of anti-skidding devices. Any regulatory legislation, it was contended, should make provision for the development of inventive genius.

This is the motor-truck man's side of the case. With all of his arguments the highway engineer and the state road official, upon whom the responsibility of road maintenance rests, will not agree. Nevertheless, the only way that workable laws can be produced is to have all available experience and points of view at hand. Enough has been said to indicate that some of the provisions of the New Jersey schedule need revision. The draft and its modification should be carefully studied by highway engineers.

This journal will be glad to receive comments on the motor-truck situation as it exists in other localities.



MOVABLE DAM AT SCOTIA—GATES AND WICKETS MAY BE SWUNG CLEAR OF THE STREAM BY ELECTRIC WINCHES ON BRIDGE, THUS PREVENTING FLOODS

New York Barge Canal Is in Partial Operation

Construction 90 Per Cent Finished—83 Miles of Eastern Section and 97 Miles of Western Section of Erie Route Now in Use for Navigation—Mechanism for Lock Gates, Valves and Movable Dams in Working Order

WITH only about 10 per cent of actual construction work remaining to be completed New York State's Barge Canal, the $155,000,000 inland waterway linking the Great Lakes at Buffalo with tidewater in New York Harbor, is rapidly reaching the transition stage which marks the passing of the constructor, the principal figure on the work for the past decade, and the advent of the operator and the shipper of freight. To-day's chief problems on the Barge Canal cannot be stated in terms of excavation or concrete yardage. They deal with new factors—organization of an operating force, manipulation of lock gates and valves, movable dams, maintenance of water levels and regulation of feeder reservoirs, generation of electric power for operating and lighting purposes and the creation of terminals and freight-handling facilities at the principal cities and towns along the route from Buffalo east to New York City.

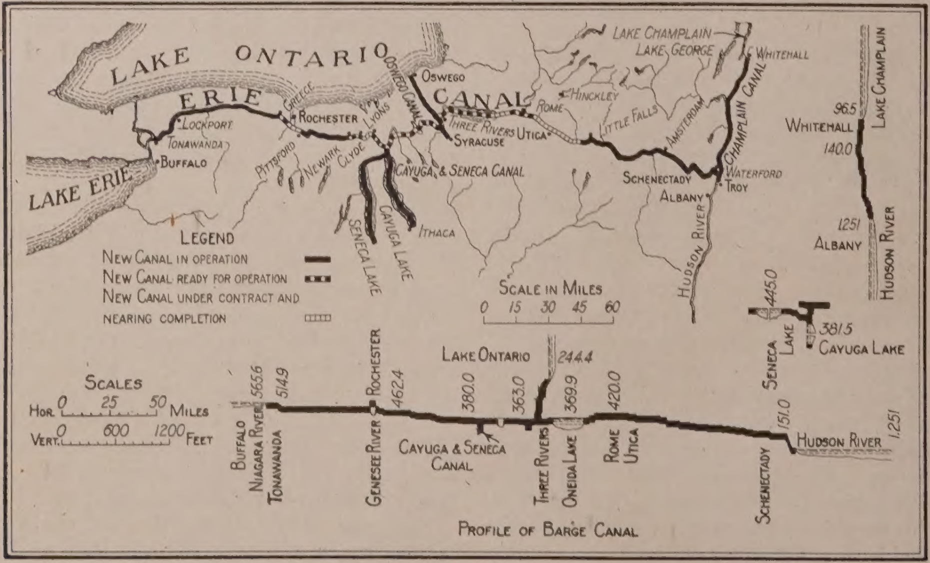
During the past season about 83 miles of the Erie section of the canal at the eastern end was finished and opened for navigation. Other sections of the route westward to Buffalo, from Newark to Pittsford and from South Greece to Tonawanda, about 97 miles, were completed and in use this year. The only points which prevent the full use of the Erie route are the unfinished work at the mouth of Tonawanda Creek, the section south of Rochester, the section from Lyons to Clyde and 4 miles from Utica to Sterling Creek. The present status of the work leads Frank M. Williams, state engineer and surveyor, to predict that the Barge Canal will be in full operation in 1918. He says that during the last year his department has solved the last big engineering problems—the Rochester and Syracuse harbors, the Irondequoit crossing, the Tonawanda movable bridges, the twenty disputed railroad crossings and the Clyde River location, which has permitted placing under contract work long undetermined.

To the Engineering Record's representative, who covered many miles of the Barge Canal work by motorboat and automobile a few weeks ago, in company with William B. Landreth, deputy state engineer; George D. Williams, eastern division engineer, and H. E. Brainard, bridge designer, an opportunity was afforded of inspecting the finished work on the eastern division, watching the locks fill and empty, seeing the gates of the movable dams rise clear of the river, and examining the hydroelectric plants which furnish power for the canal-operating mechanism and lighting. The outstanding impression created by this trip is that as a feat of engineering construction the Barge Canal work will soon be history. So much of it is completed that its annals are ready for a new chapter—on operation.

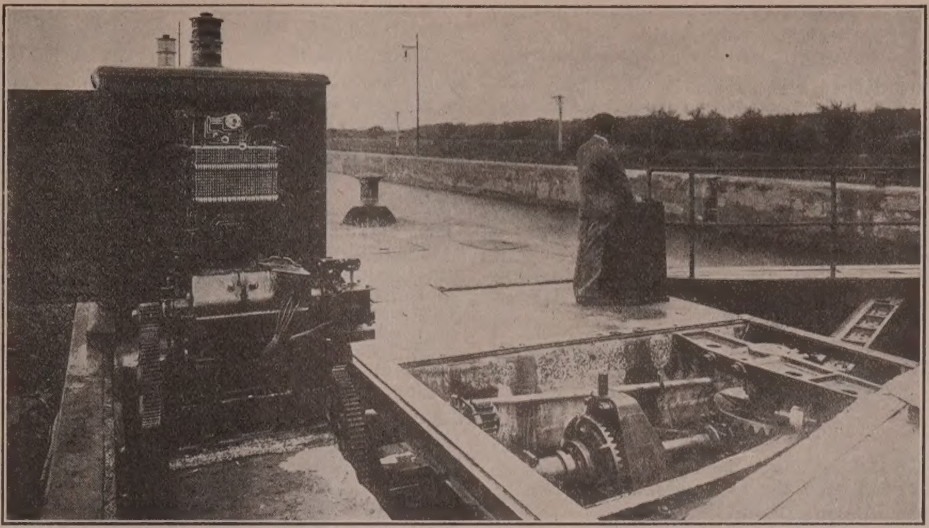
FOUR CANALS IN SYSTEM

The New York Barge Canal system, as shown on the accompanying map, consists of four parts—a main channel and three branches. The main channel, or the Erie Canal, 339 miles long, connects the Hudson River at Waterford with the Niagara River at Tonawanda. The first spur line branches off from the main channel at its eastern end and extends to Lake Champlain, a distance of 61 miles. The second spur leaves the main route at Three Rivers, extending northward to Oswego and Lake Ontario, a distance of 24 miles. The third spur, known as the Cayuga and Seneca Canal, 93 miles long, including Cayuga and Seneca lakes, leaves the main line at Montezuma and proceeds south, forking into two branches which tap Seneca Lake and Cayuga Lake respectively. In general the Barge Canal project is largely a river canalization, for 72 per cent of the length of the entire system is in river or lake channels. The length of the state's waterway system of Barge Canal dimensions—a 12-ft. depth of water and a minimum bottom width of 75 ft.—is 800 miles. Of this total about 440 miles involved construction of some type, the remaining 360 miles being in lakes or rivers which did not call for improvement.

A few statistics will give an idea of the



PLAN AND PROFILE OF NEW YORK BARGE CANAL, SHOWING PORTIONS OF COMPLETED WATERWAY



LOCK GATE MECHANISM IS ALL OPERATED BY ELECTRIC POWER

magnitude of the task of operating the New York State Barge Canal. There are, on all four canals, 57 locks, each with a width of 45 ft. and an available length of 310 ft.; the lifts vary from 6 to 40½ ft. Thirty-two hydroelectric power stations, eleven gasoline-electric power stations and three substations supply all the power for operating and lighting the 57 locks. Forty dams, some of them movable and others fixed, are needed in the Barge Canal operation. Terminal facilities are required at about 50 cities and towns along the route.

LOCK DESIGN

The lock design and operation have been practically standardized throughout the length of the Barge Canal, and while the following notes deal specifically with the flight of five locks at Waterford they apply, in a general way, to structures of the same type at other locations. The locks are of concrete construction, with an available length, for boats, of 310 ft. and a width of 45 ft. The depth of water over the sills is 12 ft.

The filling and emptying is effected by culverts in the side walls. From these culverts transverse connections are made at intervals to ports opening into the lock chambers at the bottom of the walls. The filling and emptying culverts vary in size, for with the locks of high lift a large volume of water must be admitted or discharged quickly to economize on the time of boats locking through. The culvert dimensions are 5 x 7 ft. for locks of 12-ft. lifts or less, 6 x 8 ft. for lifts between 12 and 23 ft., and 7 x 9 ft. when the lift exceeds 23 ft. Connected with the 5 x 7-ft. culverts are 16 ports, 8 on either side, while this number is increased to 22 for the 6 x 8-ft. culverts and to 28 for the 7 x 9-ft. size. The ports have been made both by embedding cast-iron pipes in the concrete and by leaving rectangular openings in the walls, the latter being the more recent method. The area of opening in either case is about 7½ sq. ft. In some of the locks there is another culvert through one of the side walls, a feature of the hydroelectric stations for operating and lighting the locks.

The gates of the Barge Canal locks are, for the most part, of the mitering-girder type, carrying the principal load as beams. They are built of steel, with single skin-plates, but have white-oak quoin and toe posts. The quoin posts swing on cast-steel pivots set in the concrete and are held at the top by an adjustable anchorage. The bearing is against cast-iron quoin plates bolted into the side walls.

Electrical power is used exclusively for all the mechanical operations at the locks, although each gate and valve is provided with hand-operating control to be used in the event of a breakdown of the power system. The lock gates are actuated by steel spars, carrying racks which mesh with gear trains from motors. Heavy coil springs are provided to absorb shocks in opening and closing. At the beginning and end of its travel the movement of each gate is slower than in the middle of the arc, this speed variation being provided for by resistance thrown in and cut out automatically in the motor circuit. Limit switches automatically stop the travel of the gate at the open and closed positions by shutting off the electric power.

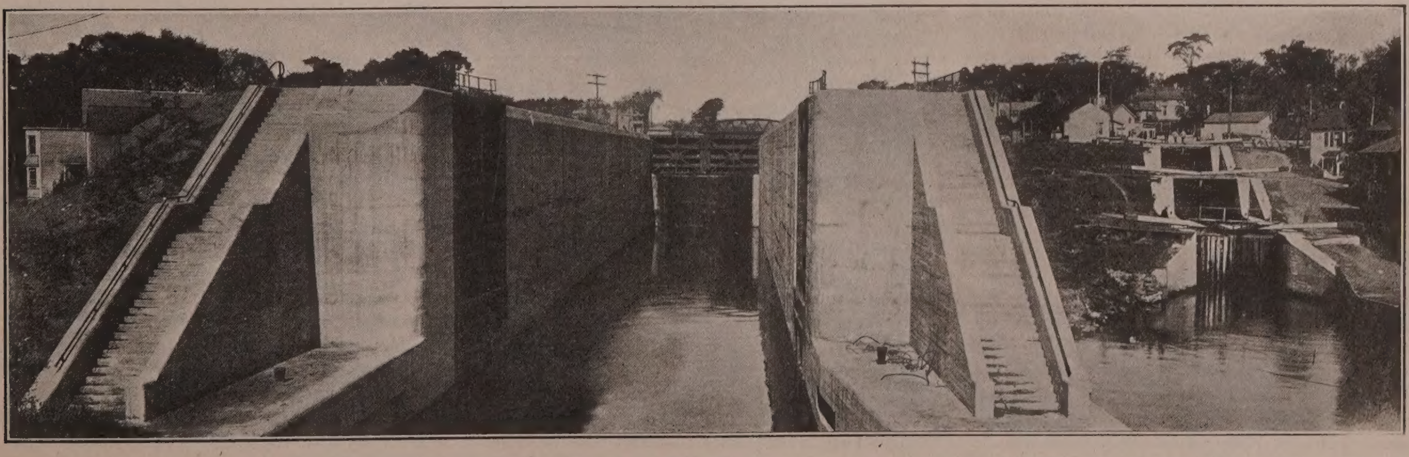
The gates, as well as the lock valves, are controlled from operating stands in duplicate, one on either side of the lock at both ends, making four in all. Thus the mechanism may be operated from whichever side of the lock proves to be the most convenient. Each operating stand is equipped with a master switch for the separate control of each of the two gate motors, valve motors and buffer beam motors. There is also a device for simultaneously locking all switches by a single key. A safety coupling, designed to release or break down whenever the load transmitted to the machinery exceeds a prescribed limit, is provided on one of the shafts. It consists essentially of two flanges connected by shear pins of Tobin bronze, the diameter of the shank on each pin being only ¼ in. Any overload, such as an attempt to open the lower gates with the lock filled, will immediately break these pins without damaging the rest of the operating equipment. In the event of failure of power or damage to the motor it is possible to disconnect the motor and operate the gates by hand by means of sweeps, which have been so designed that only two men are required for their operation.

SIGNAL LIGHTS

For the benefit of both operators and boatmen signal lights are installed to indicate the position of the gates. A green light flashes when the gate is entirely open, while a red signal is displayed when the gates are in any other position. These signal lamps are visible from either end of the lock in daytime or at night.

The operation of the culvert valves is similar to that of the lock gates, and is done from the same operating stand. The valves regulating the flow of water in these culverts are suspended on two chains which pass over chain wheels near the top of the valve wells to cast-iron counterweights. The chain wheels are mounted on a shaft rotated by a motor operating through a train of gears designed to raise or lower the valves at a speed of about 6 ft. per minute. The motors of the 5 x 7-ft. and the 6 x 8-ft. valves are rated at 3 hp., while those operating the 7 x 9-ft. valves are rated at 7 hp.

The scheme of master switches that is used for the lock gates is employed also for the valves. The signal lights, however, give more detailed information. There is a set of four lamps for each valve, three white and one blue. When all lights are out the



OLD ABANDONED CANAL STRUCTURES, AT RIGHT, DWARFED BY ONE OF THE WATERFORD LOCKS NEAR THE EASTERN END OF THE BARGE CANAL SYSTEM valve is completely closed. One white light signifies that the valve is one-third open; two white lights, two-thirds open, and three white lights, full open. A blue light indicates that the valve is closed. It will be noted that the colors of the valve lights, white and blue, are different from those for the gates, red and green, so that there can be no confusion regarding the signals.

Lock 2, the lower of the five locks at Waterford, has a lift of 34½ ft., and its filling and emptying requires the handling of about 3,900,000 gal. of water. A demonstration of the operation of this lock showed that the gates were closed in 35 seconds. The filling of the lock required about 6 minutes and emptying about 5 minutes.

ELECTRIC CAPSTANS

Electric capstans, one at each end of each lock, are provided to control the movement of boats along the approach wall and to tow them into and out of the lock chamber. A 20-hp. motor operates each capstan at a speed of about 60 ft. per minute with a pull of 8000 lb. The operation of these capstans is controlled by foot switches placed flush with the top of the lock walls. The capstan motors are of the mill type and of specially rugged design. They are placed in watertight cast-iron housings for protection against intermittent wetting by surges in the lock or by other causes. The other motors, for operating the gates and valves, also are of the mill type, and their armature and field windings have been designed to be fireproof and waterproof.

As a measure of protection for the lock gates buffer beams are provided. Prior to any locking operation they are swung out across the channel and maintain this position until everything is in readiness for the boat to proceed. The buffer beams can be used as an emergency device if it should ever be necessary to make repairs to the lock gate. Below them, in the bottom of the channel, are sills into which needles may be lowered and supported at the top by the buffer beams, thus forming a cofferdam.

HYDROELECTRIC PLANTS

At the Waterford locks operating power employed at each of the five lifts is supplied from a central plant at the Crescent dam, about 3 miles distant from the lower lock. At the other locks of the Barge Canal system, however, small individual hydroelectric plants are installed. They are operated by water from the canal and are equipped with duplicate vertical shaft turbines, which, in all but a few cases, are directly connected to 50-kw. vertical shaft generators supplying current at 250 volts. Where power is furnished to another lock not more than 2 miles distant booster sets are installed in the power station. At some of the movable dams, however, where there is probability of floods during certain seasons the hydroelectric stations are replaced by gasoline-electric outfits, with duplicate generators placed well above flood level. These gasoline-electric generators supply direct current at 250 volts, each unit being designed to furnish power for operating the locks and the adjacent movable dams and also for lighting purposes.

PRIZE FOR BEST LOCK

The operating force on the Barge Canal has been organized on the basis of three 8-hour shifts daily. At each lock there are one operator and one helper on each shift. Groups of locks are under the general supervision of lock superintendents, who live in the vicinity and can be reached quickly in an emergency.

For the purpose of increasing efficiency and creating a friendly rivalry among the operating employees Major-General W. W. Wotherspoon, state superintendent of public works, who is in charge of the operation of the Barge Canal, offers each year a prize to the crew of the lock which attains the highest standard both as to the condition of the operating machinery and the appearance of the structure and grounds. The prize consists of a small increase of salary to each man on the lock, as well as the distinction of erecting and maintaining a sign proclaiming it as the "Prize Lock." The plan, General Wotherspoon reports, has proved most successful. The men entered the competition with much enthusiasm. Not only were the mechanical parts carefully kept in perfect condition, but the rugged banks of the canal left by the contractors were leveled off and beautified. Unsightly plots of land were sodded and shrubs and flowers planted. The débris incidental to a long period of contract operations soon disappeared and at all the new locks a new order of things was soon manifest.

THE OPERATING FORCE

That the operation of the Barge Canal system is a matter of men as well as machinery is exemplified by a recent statement of General Wotherspoon's, in which he points out that efficient operation is possible only if the men have some guarantee of tenure of office as a reward for efficiency and experience. Early last year the State Civil Service Commission was consulted, with the result that examinations were devised for the positions to be filled on the new locks, and the holding of these examinations was widely advertised. The results obtained were most satisfactory to the Barge Canal officials. The new locks are now manned by young men, skilled in various mechanical trades, and in addition to the safe and proper operation of the lock machinery they are able to make repairs needed without additional cost to the state. General Wotherspoon believes that at the present time the lock organization, man for man, is equal in ability to any similar force in the employ of a great business enterprise.

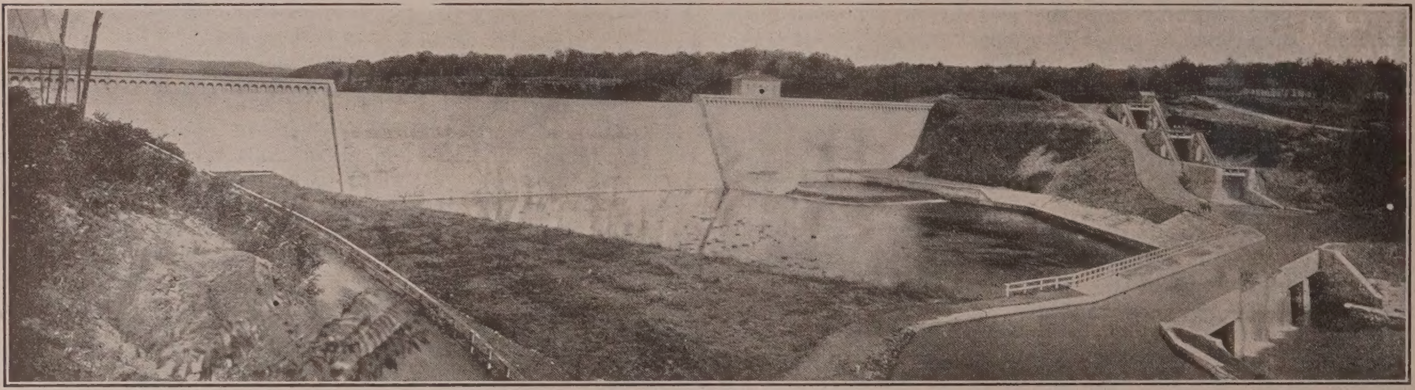
Although the operating machinery, like all similar apparatus, is of a somewhat complicated nature and is subject to disarrangement, not a single detention to navigation occurred last year at any of the locks. On the contrary, the time of passage through the new structures proved to be shorter than that necessary for passage through the old locks, although the present structures are several times larger.

MOVABLE DAMS

At certain places in existing streams used for the Barge Canal channel it is necessary to maintain water levels by means of dams of a type which can be moved out of the path of the stream during floods. If stationary dams were used at these sites the flood waters would be backed up, causing them to overflow the stream banks and inundate the surrounding territory. A representative dam of the movable type is the one at Scotia, near Schenectady. This structure has abutments, piers and a steel superstructure like an ordinary bridge, but from the downstream side hang steel frames resting against shoes in concrete sills that stretch across the stream between abutments and piers. The upright frames are 15 ft. apart and upon them run Boule gates, which are 30 ft. wide and are placed in two tiers.

These gates may be raised by chains from electric winches running on tracks on the bridge floor. After the gates are up the chain winches are employed to swing the steel frames upward to a horizontal position, such action being possible because of the hinge-like joint made by the use of a pin connection. Thus the river may be entirely freed of any obstruction in the form of a dam when a flood threatens. The electric winches receive power over a trolley wire extending to the gasoline-electric stations near the lock. It is the general practice to raise all the movable dams when the canal is put out of operation in the fall and at such other times as conditions warrant.

If there should be a break in the canal at a lock or at other points great damage would be done by the rush of water unless meas-



THE DELTA DAM IMPOUNDS WATER USED AS A FEEDER SUPPLY TO MAINTAIN CANAL LEVELS ures were adopted to prevent such a contingency. At various points along the channel are located guard gates. These are massive steel barriers hung from a bridge structure spanning the channel and may be raised or lowered electrically to prevent any sudden emptying of the canal. Just above the Waterford lock, for example, are two guard gates about 1370 ft. apart. At present the upper guard gate is operated for the passage of each boat. The normal position of the lower gate is up, but it is lowered several times a week to insure its perfect operation. The upper gate is never opened unless both gates of the first lock below are closed. This operation obviously creates a protective barrier behind the boat which has just passed it, so that if the barge should become unmanageable and crash into the lock gate the only water lost from the canal would be that below the guard gate.

WATER LEVELS IN CANAL

The maintenance of the proper water level in the Barge Canal on the Erie section is simplified somewhat by the fact that the route utilizes existing watercourses to a large extent, and the natural flow of these streams, supplemented by large storage reservoirs built therefor, is sufficient for maintaining the requisite depth and for performing lockages and incidental operations. Many of the old canal reservoirs and feeders are retained for the new channel.

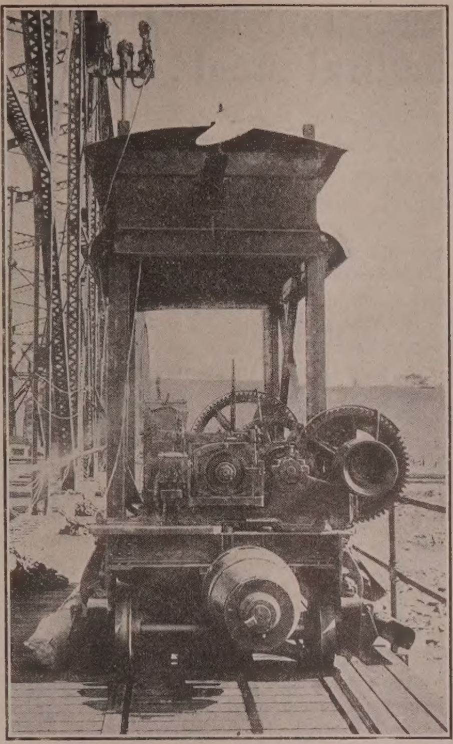
The summit level at Rome is the critical point in the canal water supply. From this point there is a continuous descent easterly to the Hudson River and westerly to the Oneida and Seneca rivers at Three River Point. West of this locality the canal ascends continuously to the Niagara River, which serves as an adequate feeder for the western section of the canal.

The Rome summit required the construction of two large reservoirs, the Delta on the Mohawk River and the Hinckley on East Canada Creek. The Delta dam, 1100 ft. long and 100 ft. in maximum height above rock, is capable of storing two and three-quarter billion cubic feet of water from a watershed of 137 square miles. The Hinckley dam, an earth structure 3700 ft. long (earth 3200 ft., masonry 500 ft.) with a maximum height of masonry of 82 ft., will store almost three and one-half billion cubic feet from a watershed of 372 square miles. This structure was completed and put into operation last fall.

As to the type of boat which the future will develop for the New York Barge Canal traffic last year's annual report of the state superintendent of public works makes this statement:

"Considering only the matter of passage of boats through the canal and without going into the subject of economical handling it would seem that the largest boat which should be used in the immediate future should not exceed 150 ft. in length and 20 to 22 ft. in width. With these dimensions a fleet of four such craft could be passed through a lock at one time, and one of the boats being equipped with power a speedy passage through the waterway would be assured. The length referred to is probably out of proportion to the proposed width, but such dimensions are given as the maximum which should be planned for at present. With such lengths no difficulty would be experienced in negotiating the various bends in the excavated prism."

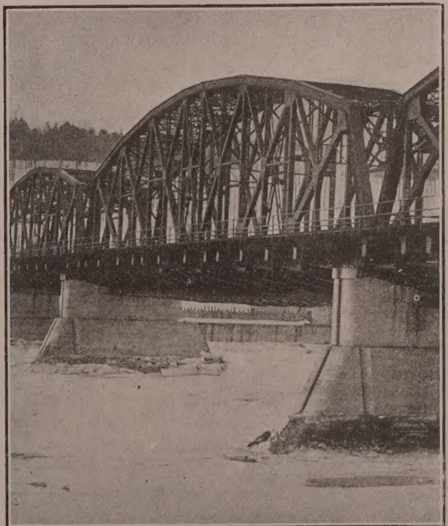
State Engineer Williams, however, believes that a considerable traffic will develop on boats built to navigate the Great Lakes as well as the canals, in which case their dimensions would be 300 ft. long by 44 ft. wide.



ELECTRIC WINCH WHICH RAISES AND LOWERS GATES OF MOVABLE DAMS

WILL SAVE FOUR DAYS

The completion of the improved canal will reduce to a considerable extent the time of passage of boats from the lakes to tidewater, and will minimize the points at which breaks, resulting in interruption to navigation, may occur. On the unimproved canal the time of passage from Lake Erie to the Hudson River of a boat propelled by animal power was estimated at ten days, and for a boat using its own motive power eight days. The average rate of speed attained by such boats ranges from 2 to 4 miles per hour. When the improvement project has been completed a greater speed may be permitted on stretches where the present canal prism has been enlarged, while on the rivers and lakes utilized as part of the route the speed to be attained will be limited only by the extent of the motive power. Since the latter condition will prevail on more than half the new route it is predicted that the time of a single trip may be reduced at least four days.



WICKETS OF MOVABLE DAMS ARE RAISED DURING WINTER

CANAL TRAFFIC

The improved New York Barge Canal system is designed for a normal seasonal traffic of 10,000,000 tons of freight. Last year's traffic over the old routes amountd to 1,858,114 tons, as compared with 2,080,850 tons in 1914. The value of shipments in 1915, however, exceeded those of 1914 by $2,332,679. With the completion of all the improvement work and the opening of the new Barge Canal throughout its entire length a marked increase in freight shipments is anticipated.

One of the most pressing needs at present, according to State Engineer Williams, is the creation of a traffic bureau to secure business for the completed canal. It is felt that the ways and means by which the Barge Canal system may be of service to the commerce of a large section of this country are but little known, despite the fact that New York State has spent millions of dollars on this work which will soon be available for use throughout its entire improved length. It would be the duty of such a bureau as Mr. Williams has in mind to disseminate information concerning the canal and go after the business of shippers of freight in the same way as do all of the railroad corporations.

ENGINEERING PERSONNEL

The construction of the New York State Barge Canal has been under the supervision of Frank M. Williams, state engineer and surveyor. William B. Landreth is deputy state engineer and D. B. LaDu is special deputy state engineer. On the three divisions of the New York State Barge Canal—eastern, middle and western—the division engineers in charge are respectively George D. Williams, Guy Moulton and F. P. Williams.

The operation of the Barge Canal system is under the direction of Major-General W. W. Wotherspoon, state superintendent of public works.

Operating Costs at Los Angeles Asphalt Plant

At the end of the first year of operation, the municipal asphalt plant at Los Angeles has saved the city $29,242, according to a report recently compiled by the city engineer. During the period between April 17, 1915, and March 30, 1916, the total output of the plant was 278,860 cu. ft. of asphalt, and for this period the books show the following figures:

Contractors' bid on 278,860 cu. ft. at 25c.		$69,715.00
Operative cost of plant	$35,606.63	
Maintenance of plant	1,992.93	
Interest, administration and depreciation	2,872.46	
Total cost		40,472.02
		$29,242.98
Plant cost to March 30, 1916	$7,773.89	
Plant equipment to March 30, 1916	420.87	8,194.76
Less depreciation charged in cost		566.99
Cost of plant less depreciation		$7,627.77
City paid for asphalt prior to operation of plant, per cu. ft.	$0.25	
Average unit cost on asphalt output	.1451	
Net profit per cu. ft. on output		$0.1049

Will Electric Welding Supplant Riveting in Fabricating Structural Steel?

Rapid Progress in Practical Application of the Spot Weld Suggests Possible Economy for Joints of Steel Frames

By G. C. HINCKLEY
Resident Engineer, Keokuk and Hamilton Bridge, Keokuk, Iowa

A DECADE ago the art of welding iron by means of the oxygen-acetylene flame was unknown. Electric welding is of still more recent origin. It is only within the past few years that these methods have emerged from the experimental to their present state of demonstrated practicability and rapidly broadening application in the metal trades. Welding concerns, confining their operations chiefly to repair work, have been successfully established in many of our larger cities. Lap-welded steel pipe and welded boilers and tanks have taken their places on our market in competition with the riveted articles.

ELECTRIC WELDING COMMERCIAL SUCCESS

Electric welding has been demonstrated a commercial success in the manufacture of sheet-metal goods, automobile frames, steel window sash, frames for concrete reinforcement, etc. Its progress is marked particularly by a rapid and pronounced tendency toward the welding of increasingly heavy sections and the perfection of larger welding units, as recently evidenced by the introduction and successful operation of an electric spot welder with a capacity equal to a butt weld of 7 sq. in. sectional area for the field-welding of connection plates across the ends of street-railway rails. There is nothing to indicate that the ultimate limit of capacity has been approximated in this machine, the probability being rather that such a limit will be controlled only by the amount of electricity economically available in any instance.

The remarkable progress in the practical application of these new methods has so far outstripped their literature and published data that the subject is marked by a dearth of definite information, resulting in a general lack of knowledge concerning the methods themselves and of appreciation of their possibilities. Lacking such detailed information, and in the absence of specific experiments and tests, it is of course impossible accurately to predict the future of these methods, especially in their possible application to new fields of industry. Nevertheless, when we consider in a broad sense their present status of efficiency and rapid growth, together with the pronounced modern tendency toward the electrification of shop processes and the universal adoption of labor-saving devices, it is logical to assume that, unless unforeseen obstacles are encountered, the electric-welding process promises within the next few years to supplant 90 per cent of the riveting in all our fabricated iron and steel products. In the shop fabrication of structural steel such an innovation would be nothing short of revolutionary in its character and attended by enormous advantages, some of the more important of which it is now proposed to point out and discuss in a general way.

A TYPICAL CONNECTION

In the first place, let us assume that the tendency will be so to design welded connections that the welds themselves will be in shear whenever possible, much as is the current practice in riveted joints. Consider a typical connection, a girder web splice, for instance, consisting of the usual pair of splice-plates with double rows of rivets, the splice being subject to the usual tension, compression and shearing stress, and then conceive of the rivets being replaced by a sufficient number of spot welds between the splice plates and the web. The great advantage of the welded splice, both in efficiency and economy, is immediately apparent, inasmuch as it involves no reduction of sectional area in the web or splice plates for rivet holes. It has been repeatedly demonstrated that the riveted splice cannot exceed about 80 per cent efficiency; the welded connection, on the contrary, may be made 100 per cent efficient, or more, depending on the total area of the spot welds, which may be grouped as closely as desired, or even joined together to produce a single large welded area. While these advantages pertain particularly to tension joints, they are nevertheless applicable in a degree to all points where rivets are now used.

It will thus be seen that the substitution of welding for riveting would result in an ultimate saving of metal in each fabricated member, roughly measured by the difference between the present so-called "gross" and "net" sections, together with a considerable saving in the weight of details, while the opportunity for a better distribution of metal in the design of sections would doubtless result in additional economy. Eventually certain modifications in the rolled shapes themselves could be expected to result in very important saving of metal, inasmuch as the elimination of rivets would permit a more efficient distribution of metal in a great many shapes, in whose design the effective section has heretofore been subjected to the necessity for providing proper riveting facilities.

COMPARING COSTS

Anything approaching an accurate comparison of shop costs between welding and riveting is of course impracticable for want of the proper welding data. Yet it is evident that, in the first place, welding would do away with the necessity for punching and reaming rivet holes, with the attendant rehandling of material in the shop, and would doubtless also eliminate fully 75 per cent of the template-making and laying-out work. The cost of manufacturing, heating and driving rivets would be replaced by that of operating the welding machine and also a sandblast for cleaning the surfaces to be welded. In view of these facts it must be conceded that, if the introduction of the welding process should prove feasible, it would result in an immense saving of shop labor, and that the elimination of the punching, reaming and laying-out operations would leave a wide margin to cover any possible increased cost of the welding operation itself over that of driving rivets. In the light of results now obtaining in the welding of smaller work, there is reason for the expectation that the total shop cost of fabrication by welding could be brought considerably below that of the present methods.

Comparing, from a mechanical standpoint, the welded and riveted types of connection, it is at once obvious that the advantage lies with the weld, in which the stress coming upon the joint is immediately and simultaneously assumed by each spot weld, the amounts carried by the individual spots depending of course on their relative areas and positions in the group; whereas in the riveted connection the application of stress acts first to overcome friction between the plates consequent upon the initial tension in the rivets, after which the rivets take stress one by one, depending, among other things, on their varying fits in the holes. Under such action, and when subject to any considerable vibration or stress reversal, a riveted joint will loosen more or less in time, resulting in a gradual loss of efficiency and an increasing tendency toward crystallization and deterioration from rust and wear.

It will be contended that the nature of a welded connection involves lack of uniformity in the quality and strength of the welds which must be met by an increased factor of safety. However, the validity of such an objection is subject to question. Inasmuch as the welding process would seem to involve no more uncertainty of uniformity than that of making and rolling the steel itself, if welding were subjected to the same systematic inspection and testing as now obtains in the steel mills, the results would be dependable in a similar degree. There is no apparent reason why the electric-welding process may not be conducted with absolutely uniform results, for once the necessary pressure, amount of current and time of application have been determined for any given thickness of plates these may readily be maintained constant throughout repeated operations.

FIELD CONNECTIONS—TESTS NECESSARY

While there is nothing in the process to prevent the continued use of the riveted field connections, the same prospect of successful welding obtains in the field as in shop work, the contractor's air-compressor plant and riveters being supplanted by a generator plant (where electric power is not at hand) and a portable electric welder, which for ordinary work should be no more cumbersome than the "bull machine" now employed for field-riveting on larger jobs. It may prove advantageous in certain field connections to employ some modification of the oxyacetylene process.

Comparative tests of welded and riveted connections on identical members are needed to verify the foregoing contentions regarding their relative efficiencies. Investigations should be conducted to determine whether the heating due to the welding process will have any injurious effect upon the steel, with a view particularly toward ascertaining the maximum thickness of metal practicable to be welded under existing conditions and the best method of increasing this thickness. A series of tests using very thin filler plates of pure iron or other substance between the plates to be welded might be productive of interesting and valuable results. Experimental work to furnish approximate data on the costs of welding structural steel is of course imperative. It is suggested that much of the experimental work could be satisfactorily accomplished by universities and technical institutes and by some of the larger structural shops.

Men Cheaper Than Machines on Trunk-Line Railway Construction in China

Bridge Caissons Sunk Without Derricks—Chinese Engineers and Contractors Show Ability with Only One Caucasian to Each Fifteen Miles of Line

By E. PARK
Formerly Assistant Engineer, Chinese Government Railways

WHEN earth embankment can be placed by man power at a cost of 3½ cents per yard it is evident that there is little use for excavating machinery in Chinese railway construction, even if that machinery cost no more in China than it does at the point of manufacture. Accordingly, in building the Canton-Hankau Railway, which in point of population served will be one of the most important trunk lines in the world, mechanical equipment is used only where absolutely necessary, as on bridge work. On one of the larger bridges, which was included in the section built under the direction of the writer, four caisson piers were sunk with air locks which contained their own hoisting engines, and the air compressors and boilers required for this work were the only plant used on the entire section.

CONCESSION ONCE HELD BY AMERICANS

This road, which will form the southern half of a line connecting Canton and Hongkong with Peking, and, through the Trans-Siberian Railway, with Europe, traverses a densely populated and fertile section of South Central China, reputed to be rich in minerals. Although its construction was first proposed by Sir McDonald Stevenson, and has occupied a prominent position in every subsequent scheme for a Chinese railway system, the road is yet far from complete. From 1898 to 1905 a concession for building it was held by an American concern, which, however, scarcely made a start on the actual construction. The northern section of this line, on which the writer was employed, was put under construction in 1912 for the Chinese government by British interests for a distance of 600 miles south from the Yangtze River through the provinces of Hupeh and Hunan. The latter province alone has, under conservative estimate, a population of 22,000,000, giving an average of more than 200 persons to the square mile. The entire outside commerce of this province is now carried on the Yangtze River, a stream more difficult to navigate than the Ohio River, which it considerably exceeds both in size and in extreme range between high and low water.

SMALL MUCK LOCK SAVES AIR

WORK INTERRUPTED BY EUROPEAN WAR

Following an energetic start on the construction of these 600 miles, the work was interrupted for almost two years, or until the spring of 1914, by the Chinese revolution. Work was then resumed, but financial difficulties consequent on the outbreak of the European war made it necessary to confine construction to the 300-mile stretch from Hankau to Changsha. This part of the line is expected to be in operation in 1917, and tracklaying at both ends and at Yochow has been started.

The southern end of the railroad from Canton north for a distance of 200 miles has been completed and put in operation by the Chinese government itself. The entire work is in charge of an organization headed by a managing director, who is a Chinese. On the portion of the line being constructed by the British the engineering chief, the auditor, the chief accountant and all the engineers in superior charge are foreigners. A Caucasian engineer is in charge of each subdivision of about 15 miles, and is the only white man on his section. His Chinese assistants, some of whom are highly educated, are for the most part very valuable and reliable. Overseers, foremen, timekeepers and the like are supposed to speak some English, and many of them have a good command of the language acquired at mission schools.

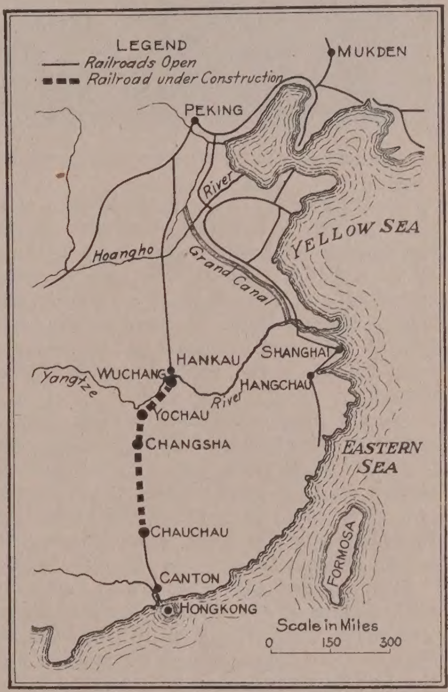
CEMENT AND RAILS MANUFACTURED IN CHINA

Two important construction materials do not have to be imported. The rails used are rolled at the Hanyang Iron Works near Hankau. The cement required is supplied partly by the mill at Tangshan and partly by the Hupeh Cement Works on the Yangtze River. The ties used are of Japanese oak, but Oregon fir has been employed very largely for structural timber. An inferior fir cut in China, where very little standing timber remains, is also used for construction purposes.

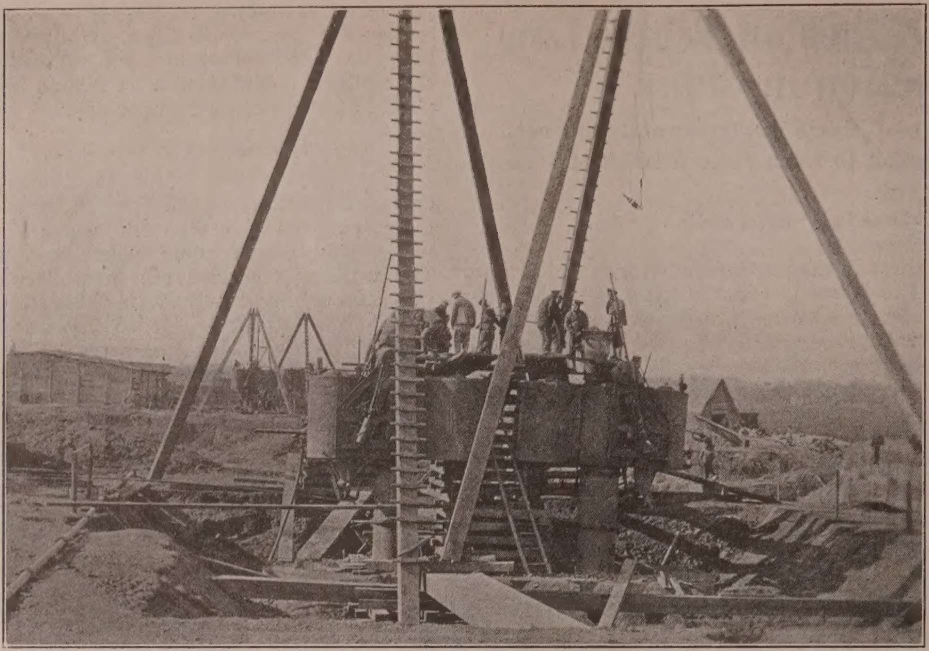
Most of the grading is done by contract for a base price of about 27 cents (Mexican money) per 100 cu. ft. for earth transported from borrow pit to fill until the height of fill exceeds 10 ft. This is equivalent to about 3½ cents per cubic yard in American money. The earth is carried in small baskets by coolies for hauls averaging 1000 ft. Payments are based on measurement in the borrow pit or in the fill, 15 per cent for shrinkage being deducted in the latter case. For ordinary grading about 500 men per mile are employed. They live in mat sheds that are moved along as the work progresses. Living on rice and vegetables, the coolies can feed themselves well on their pay of 12 to 15 cents gold per day.

HSIEN-NING BRIDGE

Fifty miles below Hankau the line crosses a tributary of the Yangtze River at Hsien-ning on a bridge for which four pneumatic caisson piers were required. The work was carried out in winter, as the surrounding territory, including most of the town itself, is flooded in summertime. The two abutments were built on 30-ft. piles of Chinese fir driven down till their tops reached low-water level. A 1-ton hammer operated by hand labor with a winch was used for driving. Two of the caissons were started in pits dug in dry land, and the other two on islands made by hand filling in the river. The working chambers, made of steel plate with semicircular ends and straight sides, were 34 x 13 ft. over all, with an inside height of 7 ft. and a total height from the cutting edge to the top of the outside shell of 8 ft. Each caisson had two air shafts 3 ft. in diameter, the shafting used being in 8-ft. lengths. The air locks, of a type common in Europe but unknown in the United States, have three compartments with a hoisting engine built into them. The drum is located at the top of the center compartment, the shaft extends through a stuffing box to the outside and the steam cylinder is fastened to the side of the lock. The center compartment over the shaft, which is always "in," is flanked on each side by a compartment for locking in and out, one used for muck and the other by the men. The main air line is direct-connected to the side of the lock. Muck is hoisted in buckets and dumped into a funnel riveted to the bottom of the muck compartment, which is a small lock itself, and from which the muck drops to a platform or into baskets. Coolie transportation was so cheap that the material excavated from these caissons was carried back and put in the approach fills.



DOTTED LINE INDICATES RAILWAY BEING BUILT BY BRITISH



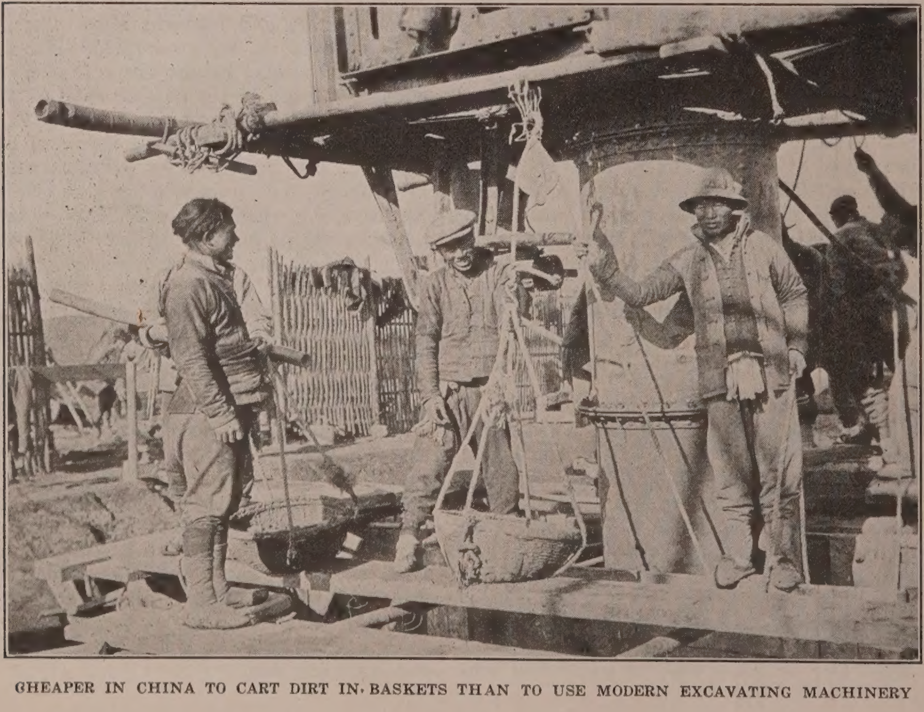
CONCRETING WORKING CHAMBER THROUGH SMALL TOP LOCKS—TRIPODS HANDLE MAIN LOCKS

Shafting was put on by hand during sinking, the lock being suspended during the change by heavy tackle from a tripod of 12 x 12-in. timbers, the legs of which rested on the ground clear of the caisson. One of these tripods was erected over each lock at the start of sinking, and remained in place until the locks were finally removed.

An air plant consisting of four boilers and two single-stage straight line compressors of British manufacture was installed on each side of the river, so that two piers could be sunk at the same time. In addition to this plant, a small boiler was set up at each caisson for the lock hoist.

Sinking was carried on day and night with a gang of sixteen men in each caisson. Ten men were required in the working chamber and three in each air lock, besides the hoisting engineers, who worked on top of the locks. The piers were sunk through gravel and clay to boulder clay, about 40 ft. below water level. One of the piers rests on limestone. The concrete was carried up 8 ft. at a time, and only one set of forms was used for each pier. Sinking was suspended until each lift of concrete set, but was usually resumed before the forms were removed. These forms were made of 3 x 6-in. plank 8 ft. long, which were held together at top and bottom by an outside band of steel rail, flange turned in against the plank and secured to them with ordinary track spikes. The curved ends were made by cold-bending two lengths of rail to a quarter circle and fastening them together and to the straight rails at each side with ordinary fish plates. The rail arrangement is not shown in the photograph, which was taken early in the work, but proved much more satisfactory than the first method tried of fastening the plank with U-bolts to flat straps. The upper and lower lines of rail were spaced and held together by $\frac{3}{4}$-in. bolts incased in bamboo.

All the concrete was, of course, mixed by hand. It was lowered to place inside the form in baskets, no dumping being permitted. The working chambers were concreted through small locks attached to a top door in the center compartment, thus permitting the concrete to be locked through in a short time and dropped clear to the bottom of the caisson. One of these working chambers which the Chinese desired to finish to avoid working overtime on a holiday was concreted in this way in 12 hours.



CHEAPER IN CHINA TO CART DIRT IN BASKETS THAN TO USE MODERN EXCAVATING MACHINERY

CHINESE CONTRACTOR DOES SINKING

The actual sinking was done by a Chinese contractor, Chang-Fung Tsai. For $15, Mexican money, per vertical foot he supplied labor for running the air plants, excavating and hoisting the muck. The erection of the working chambers, changing of the shafting, concreting and disposing of the muck were done by day labor. The railroad supplied all stores, such as coal, oil, kerosene, candles and even cowhide for making shoes for the workmen.

The engineer in chief on the construction work in charge of British interests on this railroad was A. G. Cox. The engineer of the first district, including Hsien-ning, was A. G. Roberts, while the writer was in charge of the sixth subdivision, including the bridge work described, as assistant engineer.

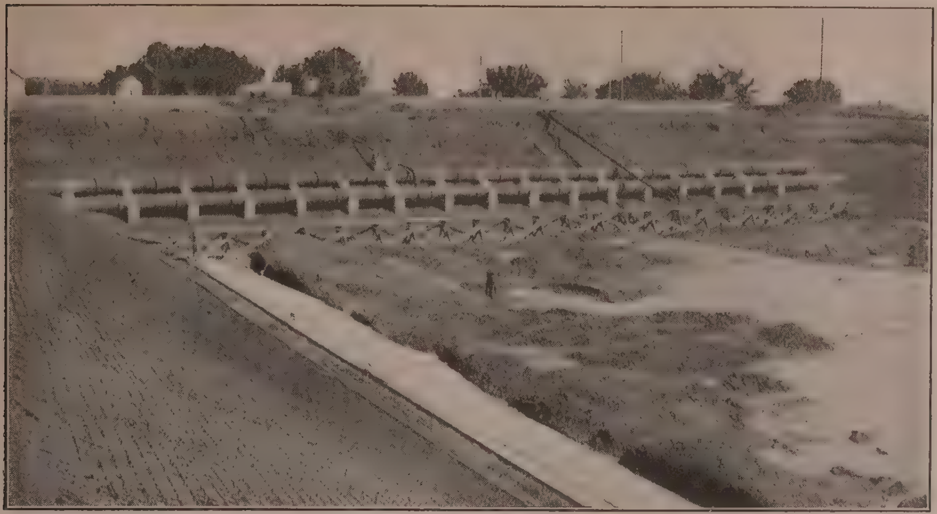
Auto Truck Helps Double Oiled-Street Mileage

87 Miles of Roadway in St. Louis Have Been Oiled During the Past Summer at a Cost of $313 per Mile

EIGHTY-SEVEN MILES of roadway in St. Louis have been oiled the past summer at a cost of $313 per mile. This is double last year's record, and, according to a statement made by J. L. Laxton, engineer of bituminous roadways, in a recent paper presented to the St. Louis Engineers' Club, is due to the addition of a 1000-gal. autotruck oiler to the former equipment of eight 500-gal. converted sprinkling wagons and one combination tank and boiler for heating. The cost is considered low, however, for quite a number of miles were added at the close of the season that received only one or two applications. For extra-wide streets, like the Kingshighway, the cost is $450 per mile.

The method of oiling that has been found to give good results is to apply first $\frac{1}{6}$ gal. of light oil at a temperature of 125 deg. Fahr. It penetrates quickly owing to its volatile nature. Several days later, the time depending on the climatic conditions and rapidity of penetration, $\frac{1}{4}$ gal. of heavy oil is applied under a pressure of 20 lb. The light oil thoroughly impregnates all dust particles on the roadway, rendering them too heavy for flight. It also acts as a lubricant for the heavy oil, thus enabling it to penetrate quickly, and obviating the necessity of covering with sand or other material. The roadway is waterproof, and there is no criticism from citizens such as comes from the usual uncovered oil road.

Extreme care must be exercised. Too much oil, particularly heavy oil, acts as a lubricant, and assists the creeping of the macadam under the action of traffic. Ordinarily, three applications of the heavy oil at the proper intervals will maintain the roadway in good condition during a season.



FAR SLOPE POURED FROM CHUTES ON TRUSSED RUNWAY OVER TWO 36-INCH PIPE LINES
Material on floor has been trimmed from slopes ready for removal by hydraulic method.

Water Basin for City of Omaha Constructed by Day Labor, Using New Special Devices

Formed Ties for Steel Reinforcement Effect Economy—Daily Records of Concrete Materials Are Basis for Proportioning

By HOMER V. KNOUSE
Construction Engineer, Metropolitan Water District, Omaha, Neb.

SINCE the purchase in 1912 of the plant of the Omaha Water Company by the city of Omaha practically all concrete work has been done by day labor. The act of the Nebraska legislature which created the Metropolitan Water District of Omaha was so drawn as to give the management of the plant to a bipartisan board of directors, which was to select as general manager a "civil and hydraulic engineer." This act provided for a plan of organization that definitely removed the water department from local politics and made possible a policy of operation along the most markedly advanced economic lines. A closely co-ordinated organization under the direct and unhampered supervision of the general manager, a policy of competitive purchasing of supplies and construction material and the prompt payment of bills, and the employment of all classes of labor on an efficiency basis have made possible the operation of the plant and the construction of more than $1,000,000 worth of improvements.

OMAHA'S WATER SUPPLY

The city of Omaha obtains its water supply from the Missouri River, the intakes, settling basins and pumping station being located at the adjoining town of Florence, about 6 miles upstream from the business district of Omaha. The turbidity of this stream varies from 30 parts per 1,000,000 during the winter months to a maximum of 12,000 parts per 1,000,000 during the early summer. The clarifying treatment consists of coagulation and sedimentation, and except during a short period in the early part of the spring months at the time of the break up of the ice in the river it has been possible to obtain a satisfactory quality of water. During this period, however, it was not always possible to keep the water at the high standard desired, and at other times the amount of coagulant necessary was so great as to make the cost of treatment excessive.

To overcome these two undesirable conditions Basin 6 was proposed, which, together with additions to and changes in the supply lines and weirs, would provide at all times a satisfactory quality of water at a greatly reduced cost. The basin was filled in November, 1915, and placed in operation in the spring of 1916 for use during the breaking up of the river, and results to date make it appear beyond a doubt that it is fully meeting the requirements imposed upon it.

EXCAVATION AND EMBANKMENT

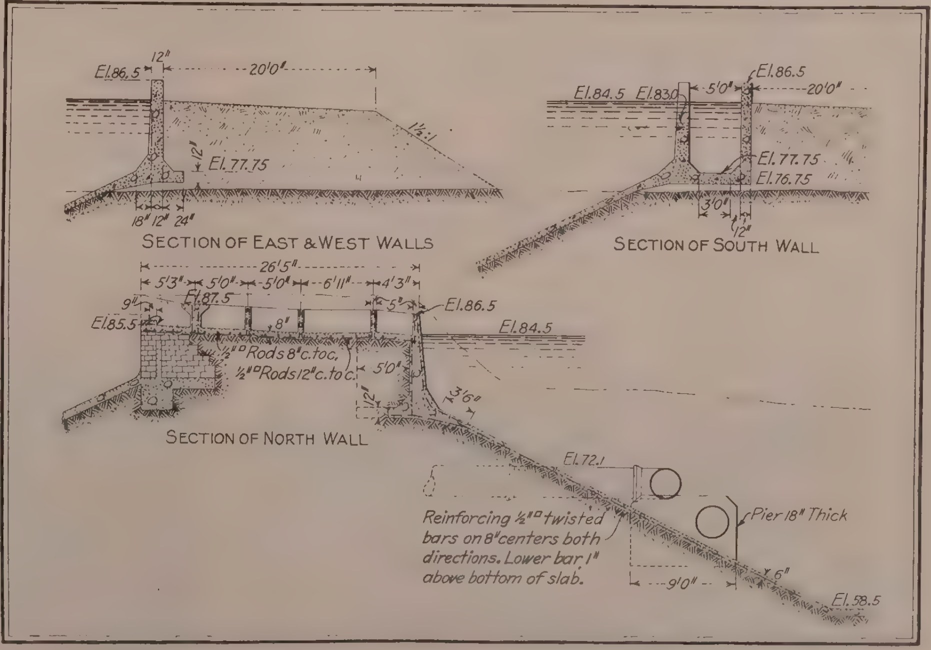
The basin has a capacity of 15,000,000 gal. and is constructed partly in excavation and partly in embankment. The material was removed by elevating graders, dump wagons and wheeled scrapers, and deposited on the embankment, spread in 6-in. layers, thoroughly wetted, and compacted with 10-ton road rollers. The middle third of the embankment was kept at a lower elevation than the sides, and special precautions were taken on the inner edge to insure a high degree of density. The earthwork was completed in the fall of 1914, with the exception of about 1 ft. of excess material on the inner slope, which was left to prevent erosion below the desired finished grade.

The slopes were trimmed to grade in the spring of 1915, and with the aid of the hydraulic or sluicing method the material was removed cheaply. Prior to the construction of the embankment, sewers for emptying and washing the basin had been constructed, and through these the material trimmed from the bottom was washed out with the aid of a hose stream. Following the concreting of the floor, the slopes were trimmed and the material placed on the finished floor and removed in a similar manner after the completion of the basin.

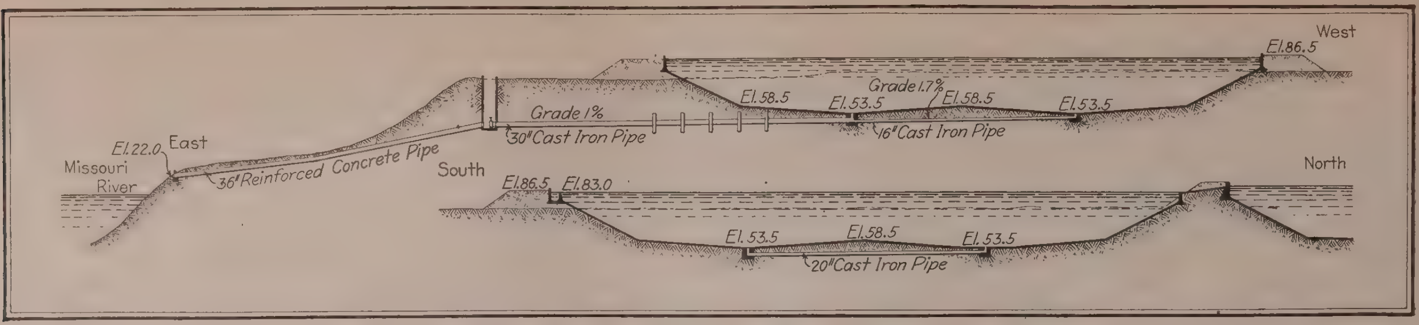
LINING OF FLOOR AND SLOPES

The slopes were trimmed by cutting narrow trenches at intervals of about 12 ft. to the finished lines of the earthwork and removing the larger part of the material between by means of a fresno or wheeled scraper attached to the hauling line of a steam hoist. The line was reeved from the hoist through a sheave on a movable deadman on the basin floor, and thence to the fresno. This gave a pull into the basin, and the fresno was brought back to a digging position at the top of the slope by a tag line attached to the handle of the fresno and operating over the niggerhead of the hoist. Trimming to the exact lines was done with hazel hoes, the material being so compact as to require a sharp cutting edge.

The lining of the floor and slopes consists of a monolithic slab of concrete 6 in. thick, reinforced in both directions with ½-in. square twisted bars on 8-in. centers, with the lower bar 1¼ in. above the bottom of the slab. In the corners additional reinforcing was used parallel to the slopes, also where the slab crossed the line of the trench excavated for the sewer. Above the slopes is a vertical wall section, with a double wall on the south side to form a skimming weir and collecting gallery. The spillway on the



SECTIONS THROUGH BASIN 6 SHOW REINFORCEMENT AND VARIOUS DETAILS



PROFILE OF DRAIN FOR BASIN 6, SHOWING HOW FLOOR IS SLOPED TO FORM POCKETS

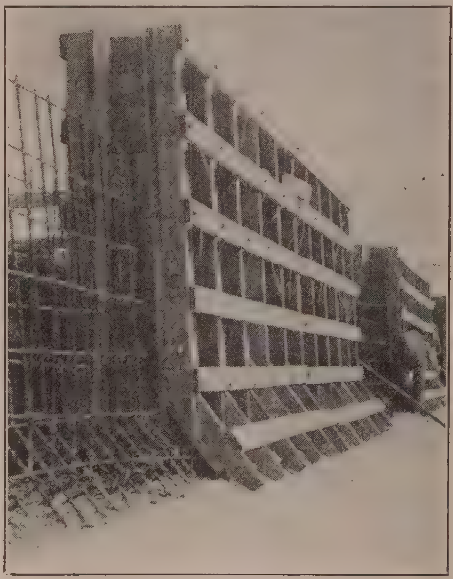
north, between Basins 4 and 5 and Basin 6, is a slab similarly reinforced, and the baffles are reinforced and tied into the floor with vertical bars.

All reinforcing steel was tied at approximately every fourth intersection by the use of formed ties instead of the usual annealed-iron wire ties. The shape of these ties permits their use as supporting chairs. During the progress of the steel placing these chairs were allowed to sink into the earth to prevent deformation; but immediately before the placing of the concrete the steel mat was raised and a short piece of lath inserted under the chair. It is believed that this type of chair effected a decided economy in the cost of placing the steel. To insure the rigidity of the mat during the pouring, in addition to the certainty of its being in its proper place in the slab, the use of this chair seemed imperative.

Uniform Density Obtained

The concrete was proportioned 1:3:5, using Portland cement, washed Platte River sand and crusher-run limestone without dust. Integral waterproofing mixed with the tempering water was utilized throughout. While the proportions were approximately as mentioned, they were varied somewhat to give a concrete of uniform density even though the grading of the rock varied. The wheelbarrows employed in charging were of a uniform size, and by the use of boards dapped at the ends, so as to drop the striking edge more or less below the top of the body of the wheelbarrow, the load could be struck off to a predetermined amount, different boards being used when a different size of load was desired. Every load, both of sand and rock, was measured in this way, and by means of a specially designed gaging tank above the mixer the quantity of water per batch was made absolutely uniform.

It was thus possible to control the consistency of the concrete without resort to the judgment of the operator, and the value of the method was clearly demonstrated. It was found that the consistency of the concrete at which it could be handled best in the chutes was that at which it could be placed on the slopes without slipping, as well as that at which minimum separation occurred in wheeling from the mixer to the chute or forms, and the extra labor involved in charging the mixer was more than compensated for in the reduced cost of placing. A further advantage in this method, and probably the most important, was apparent in the appearance of the concrete, for the separation of the aggregate was so slight as to be readily overcome by spading within the forms.



WOOD FORMS USED FOR 20-FOOT WALL

Steel reinforcement continuous from slope slab into wall

Determining Proportions

The method used in determining the proportions from day to day is shown in the "daily log," reproduced herewith. Daily measurements of concrete placed and of material used were made, and the concrete judged from the computed data on this report. The factor that was used as the index of the quality of the concrete was item q, "Excess mortar to voids," and it is believed that this method may be safely substituted for the method of mechanically graded mixtures on work where the cost of equipment for the latter plan would be prohibitive. This report was in the hands of the construction engineer each morning for the previous day's run, and from it the proportions for the start of the day's run were made. While this method does not entirely eliminate the human element in the proportioning of concrete, it was found to be a valuable aid, and remarkably constant results were obtained during the progress of the work.

In pouring the floor the concrete was conveyed in two-wheeled buggies from a hopper supplied from the mixer by a chute. The slopes were poured by using a trussed chute receiving concrete from buggies, as described in the Engineering Record of Oct. 16, 1915, page 491. The arrangement for dumping the buggies into the wall forms was shown on page 28 of the issue of Jan. 1, 1916.

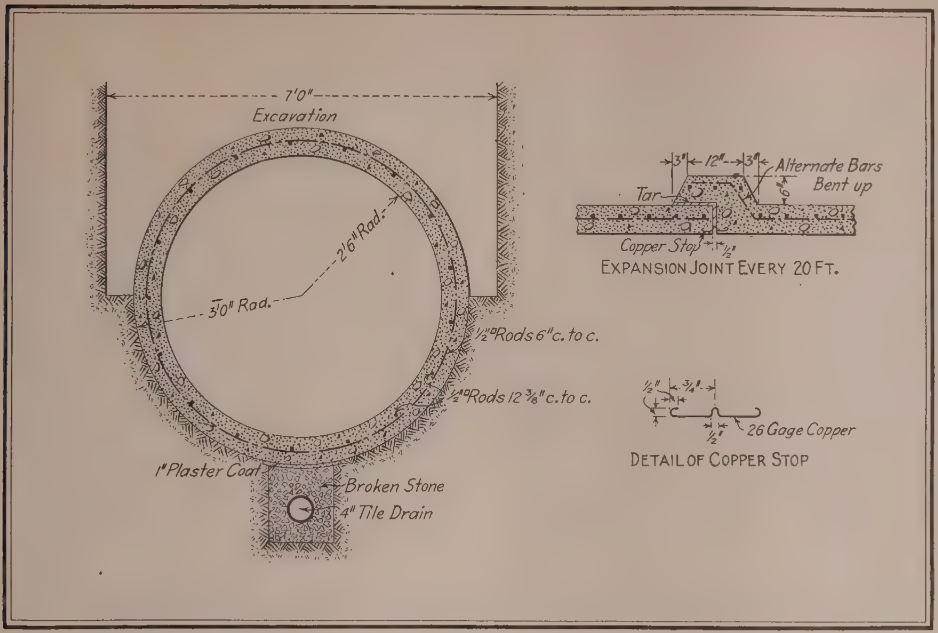
Concrete Placed in Horizontal Courses

The concrete on the slopes was placed in horizontal courses around the basin, since it was thus found possible to work the concrete at a consistency best suited to reinforced work without the slipping of the fresh concrete due to the high head resulting when worked in vertical strips. The joints being horizontal, fresh concrete placed against the old tended to work down against the former, and this, together with the fact that a complete horizontal course could be placed in a day, resulted in good joint efficiency.

Dilute hydrochloric acid, a clear-water wash and a neat-cement grout were applied in turn to the face of the old concrete just in advance of the placing of the new course, special care being taken to remove all dried concrete not covered by the protecting canvas, or pieces that had become shattered in removing the forms. The floor and slopes

VIEW SHOWS VARIOUS STAGES IN CONSTRUCTION OF FLOOR

LONG-HANDLED 12 X 24-INCH FLOATS PRECEDE STEEL TROWELS



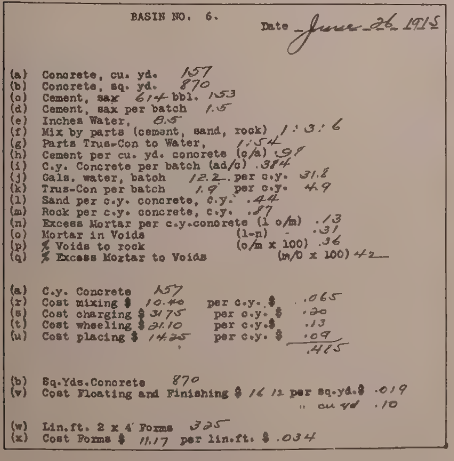
DETAILS OF 60-INCH CONCRETE BYPASS PIPE DESIGNED FOR 10-POUND HEAD

are of the one-course type such as is being generally used in paving work, no topping or mortar coat being used. To absorb the excess water that was flushed up during the floating, a dry mixture of sand and cement was applied in small quantities with sand riddles, sufficient to enable the finishers to obtain a smooth finish. Long-handled floats were used, both on the floor and slopes, with excellent results.

VERTICAL WALLS AND FORMS

The vertical walls were built in 20-ft. sections, except that each corner, with 15 ft. of tangent on each end, was built as a unit. Expansion joints between each section were made by applying to the end of the section first poured alternate layers of asphalt and tarred felt, the latter being ironed into the asphalt by special-shaped irons to fit the modified V-joint. Forms used were of 2-in. lumber built in 20-ft. sections on tangents and in 5-ft. sections on curves. These were readily handled and pulled by a very light derrick, and due to the high-salvage value of the lumber in general waterworks operation this proved to be an economical material. The average number of reuses of the 12-ft. forms was six, and with the 5-ft. forms a reuse on each of the four corners was possible.

The floor of the basin is divided into four pockets to provide a greater slope to the sewers to aid in washing, these pockets having a maximum depth of 5 ft. The mud valves placed at the sewer openings have a horizontal gate on a vertical stem actuated by a hydraulic cylinder, and are controlled by means of pressure pipes leading to vaults outside the basin walls. Valves of this design have been in use in older basins of this plant for 25 years, and have proved well suited to the service.



BASIN NO. 6.

Date June 26 1915

(a) Concrete, cu. yd. 157
(b) Concrete, sq. yd. 870
(c) Cement, sax 614 bbl. 153
(d) Cement, sax per batch 1.5
(e) Inches Water, 8.5
(f) Mix by parts (cement, sand, rock) 1:3:6
(g) Parts Trus-Con to Water, 1:54
(h) Cement per cu. yd. concrete (c/a) .98
(i) C.y. Concrete per batch (ad/c) .384
(j) Gals. water, batch 12.2 per c.y. 31.8
(k) Trus-Con per batch 1.9 per c.y. 4.9
(l) Sand per c.y. concrete, c.y. .44
(m) Rock per c.y. concrete, c.y. .87
(n) Excess Mortar per c.y. concrete (1 o/m) .13
(o) Mortar in Voids (1-n) .31
(p) % Voids to rock (o/m x 100) .36
(q) % Excess Mortar to Voids (m/0 x 100) 42

(a) C.y. Concrete 157
(r) Cost mixing $ 10.40 per c.y. $ .065
(s) Cost charging $ 31.75 per c.y. $ .20
(t) Cost wheeling $ 21.10 per c.y. $ .13
(u) Cost placing $ 14.25 per c.y. $ .09
.485

(b) Sq.Yds.Concrete 870
(v) Cost Floating and Finishing $ 16.12 per sq.yd. $ .019
" cu yd .10

(w) Lin.ft. 2 x 4 Forms 325
(x) Cost Forms $ 11.17 per lin.ft. $ .034

DAILY LOG SHEET CONTROLS PROPORTIONS

The design of the north side of the basin is such as to cause the influent to be discharged across the entire width of the basin; and with the gallery extending across the south side, "short circuits" or fan-shaped flow areas are impossible. On the north side 6-in. vitrified tile elbows are set in the wall, looking down, and receive the influent from the baffled spillway. By the use of stop plank of varying heights it is possible so to control the flow of water through the baffle openings that the discharge from these tiles is equal under all conditions of operation.

CONCRETE BYPASS PIPE

The 60-in. concrete bypass pipe from the south end of Basin 6 to Basin 3 and the 48-in. pipe from this point to Basin 2 are designed for a head of 10 lb. to the square inch, and are provided with copper expansion joints at the end of each 20-ft. section. Each section, invert and arch, was poured as a unit, thus obviating all construction joints at the springing line. Collapsible steel forms were used for the interior, the lower side of the invert being formed by suitable excavation of the trench, and the upper side of the arch by wood forms. The reinforcing was placed as shown in the accompanying drawing. The special construction in this line included a 90-deg. bend, a 60 x 48-in. tee, a 60 x 48-in. reducer and a 60-in. twin 36-in. tee for the outlet into Basin 3. All were executed in reinforced concrete, connection being made to 36-in. cast-iron pipe where necessary. An open mixing chamber or flume 240 ft. long in the bypass line provides a means for thorough mixing of the coagulant before the water being treated enters Basin 3.

This work was carried out under the direction of R. B. Howell, general manager of the Metropolitan Water District of the city of Omaha. The contractors for the earthwork were the Kierle Construction Company and J. P. Williams, and the concrete bypass was constructed by the Offerman Construction Company. All other work was done by water district forces. George T. Prince is chief engineer of the water district; A. B. Hunt, superintendent; H. S. Nixon, assistant engineer, and the writer had active charge as construction engineer.

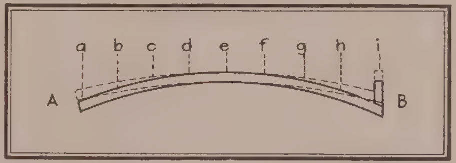
Tests Needed to Verify Concrete-Road Crack Theory

Unequal Saturation of Ground in Cold Weather Accountable for Longitudinal Openings

By S. WHINERY
Consulting Engineer, New York City

THE CAUSE of the frequent longitudinal cracking of concrete pavements and roads has not yet been adequately explained. The observed facts are that such cracks seemingly occur during the winter months, though they usually do not become observable until the warmer weather in the spring; that they are usually found in the middle third of the width of the pavement; that they seem generally to begin at expansion joints regardless of the different spacing of these expansion joints; that they occur most frequently where the pavement is laid on clay or other impermeable soils; that they occur in reinforced pavements, though not so frequently as in those not reinforced, and that they occur in narrow as well as wide pavements.

For reasons not necessary to detail here, temperature expansion and contraction of the concrete itself does not offer a sufficient explanation of their occurrence, and some other general cause must be looked for.



METALLIC LEVELING PINS SHOULD BE FIXED TRANSVERSELY TO DISCLOSE DISPLACEMENT BY HEAVING

From study and observation I believe that the cause will be found in the unequal expansion or heaving by frost of the earth under or around the edges, or curbing, and that under the central parts of the pavement, due not only to the different water content of the earth at the sides and central part of the pavement, but to the different temperatures to which the two parts are subjected. It seems to be a well-established fact that the amount of expansion or heaving of earth by frost is, substantially, directly as the quantity of water contained, up to the point of saturation.

Referring to the accompanying sketch, I conceive that the normal contour of the pavement, shown by full lines, may under the influence of heavy rain succeeded by severe freezing be forced into the contour shown by the dotted lines. If the pavement has no curbing, as shown at A, the water from the natural rainfall, supplemented by that draining from the pavement, would saturate the earth at the edge of the pavement; but this water would percolate slowly into the subgrade and would not be evenly diffused under the pavement for some time, particularly as it must flow slightly uphill.

If in the meantime a severe freeze should occur, the difference in the quantity of the water in the soil at the edge and the center of the pavement aided by the difference in temperature at the two points would result in a difference in the elevation by ice expansion or "heaving," forcing the pavement into the contour shown by the dotted lines; and if the resulting deformation were sufficient the pavement must yield by longitudinal fracture. The maximum moment of the upward force at the edge and the maximum stress on the concrete—assuming both sides to be acted upon—would be at the center of the street, and the cracking would be most likely to occur there, other things being equal. The cracks would naturally begin at the expansion joints where no support is afforded by the adjoining slab.

If the pavement has a monolithic curb, as shown at B, the water from the roadway would be carried away, but the back of the curb would supply an additional hold for the grip of the heaving earth. It is not unusual in severe climates for deep-set, detached curbs to be thus gripped and lifted.

A longitudinal crack thus formed would at first be V-shaped—open at the bottom and closed at the top—until the disappearance of frost from the ground, when the sides would sink to their normal position. In doing so the tendency of the pavement would be to move slightly outward and the crack would appear on the surface.

TESTS SHOULD BE MADE

The foregoing seems to be a rational theory to account for longitudinal cracking, but it needs to be verified by accurate investigation, and the principal purpose of this article is to suggest that engineers who have the facilities for doing so should make accurate and systematic observations to determine the true cause of this longitudinal cracking.

The following suggestions for such a study are offered:

Select points on several concrete pavements or roads where longitudinal cracking has occurred or is likely to occur. Along a line at right angles to the street, as shown by the letters a, b, c, d, e, f, g, h, i, set metallic leveling pins properly protected from displacement by travel or accidents; take and record the accurate elevation of each pin at different times and seasons, particularly in the autumn before freezing weather, and several times during the winter, especially when the ground is most deeply frozen. Also, at the same time, measure accurately and record the horizontal distance between the outside pins (a and i) to detect any horizontal movements. The levels should be referred to some permanent benchmark not affected by frost, as on a building with deep foundations.

Such a series of tests should throw light on the actual cause, whether it confirms the previously mentioned theory or not. The details of preparing for and making such tests properly need not be gone into; they will occur to every competent engineer. Whatever the results may be they should be published in the technical press, stating all the conditions under which the investigation was made.

Engineering Students Favor Spanish

Out of 231 students entering Stevens Institute of Technology this fall, 180 have elected to study Spanish instead of French or German.

Theory and Tests Presented for Design of Sand Boxes to Lower Arch Centers

Importance of Lowering Devices Discussed and Various Types Described —Amount of Settlement Caused by Compression of Sand Determined

By FRANK P. McKIBBEN
Professor of Civil Engineering, Lehigh University, South Bethlehem, Pa.

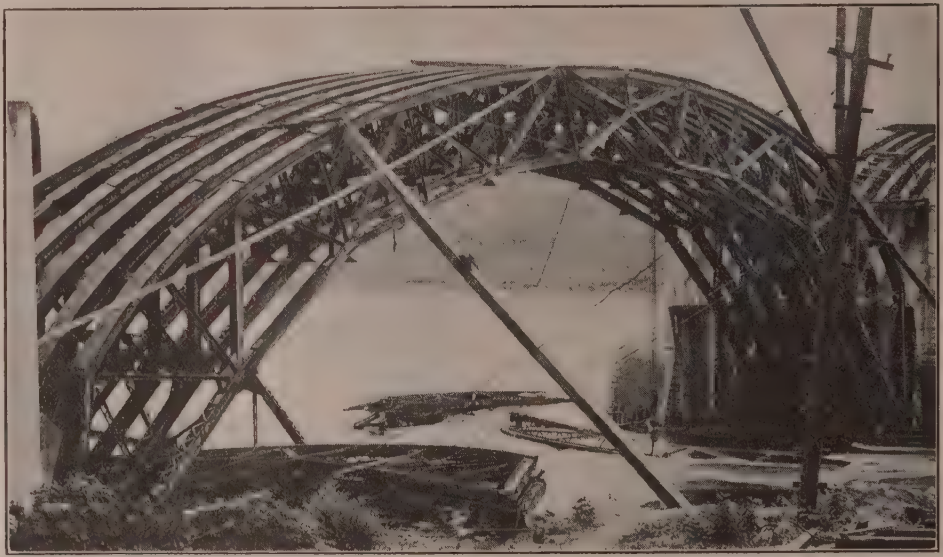
STEEL CENTERS used in molding the concrete arches over Rocky River, Cleveland, at the Delaware River crossing of the Delaware, Lackawanna & Western Railroad, at Penn Avenue Viaduct in Reading, Pa., and at the new Susquehanna River Bridge at Harrisburg, Pa., indicate a tendency to secure a simpler and more nearly determinate form of temporary construction than the labyrinth of wooden posts and braces employed for so many centuries as arch centers. Clearly, this desire leads to the use of fewer parts in the form of ribs wherein stresses can be determined with great accuracy after the loads are once found. These larger units in centers necessitate the use of some positive form of lowering device, and it is not a simple matter to secure a cheap and efficient support for heavy loads that will act only when and as wanted.

LOWERING DEVICES IMPORTANT

The necessity of properly lowering the centers after the arch is capable of supporting itself is seen when it is realized that by sudden or careless lowering the ring may be subjected to one or more upward forces, more or less nearly concentrated, acting on its soffit—forces which are indeterminate and not contemplated in design. The bending moments set up by these forces may cause the arch ring to crack, and if the latter is reinforced the adhesion between steel and concrete may be overcome and the steel highly stressed. It seems difficult to imagine a case when any serious damage, such as a collapse, could result, but cracks are certainly undesirable, causing unknown stresses from changes in location of the thrust line.

VARIOUS LOWERING DEVICES

The requisites of a lowering device are: It shall safely carry for the required length of time the maximum load to which it will be subjected; its effect on the settlement of the centers can be predetermined; lowering can be accomplished under definite control and with ease, and finally, the cost must be reasonable. The five devices that have been proposed or used to meet the requirements are: Wooden wedges, steel-screw wedges, screw jacks, hydraulic jacks, and sand boxes, Of these, wooden wedges are by far most generally used, and for smaller structures on wooden centers they can be made to act efficiently.



SPECIAL STEEL CENTERS USED IN CONSTRUCTION OF DELAWARE RIVER BRIDGE

Toggle-joint arrangement at panels next to crown; double screw jacks in the posts lower the centers.

In long-span arches, however, the use of wooden wedges may be accompanied by serious difficulties. Thus, in the centers of the Walnut Lane main arch the wooden wedges, which were cut from 10 x 10 x 18-in. timbers, were so arranged that the unit bearing pressure across the grain, 1000 lb. per square inch, was the same as the unit compression along the grain of the vertical posts—a condition which resulted in crushing the fibers across the grain. In striking centers considerable difficulty was experienced in starting some of the wedges, so much so in fact that jacks were used to reduce pressures, and even then one wedge had to be cut out. Such high unit bearing across the grain should not be allowed even for temporary construction. If wooden wedges are to be efficient the loads must be distributed with metal plates, channels or wooden corbels so that in no case does the unit bearing across the grain exceed 400 lb. per square inch for timber suitable for centers. The simplicity and cheapness of wooden wedges cannot be disregarded, and for small structures, or for large ones when loads are carried at many points, they can be made to give good service. Screw jacks or those operated hydraulically have not been often used. The great objections to ordinary screw jacks are that they are difficult to operate under heavy loads and are not especially stable, while for light structures their cost is prohibitive. Double-screw cast-steel wedges were used at the Rocky River arch, although their cost is said to have been in excess of that of sand boxes.

SAND BOXES

The idea of having steel cylinders filled with sand which can be withdrawn to lower the centers seems to be a good one, and for concrete arches with steel or other centers where heavy loads are concentrated at few points no good reason for not using sand boxes is apparent. For cases where applicable they are probably the cheapest form of lowering device obtainable, and seemingly possess the further advantage of greater stability as compared with ordinary screw jacks. The simplest form of metal sand box consists of a flat plate bottom to which is connected by a circular angle a steel cylinder made of a thin plate with a longitudinal riveted lap joint with countersunk rivet heads on the inside. A solid wooden plunger of diameter just sufficient to fit in the steel cylinder, and to clear the countersunk rivets, rests on the sand within.

For lowering centers, the removal of one or more plugs in the side of the cylinder near the bottom allows the sand to run out or to be scraped out as the plunger descends into the cylinder. Sand boxes were successfully used with ordinary wooden centers in each of the two main 230-ft. spans of a three-hinged reinforced-concrete arch highway bridge over the Isar near Grunwald, Austria. They were also used to release the falsework under the ill-fated suspended span of the Quebec Bridge at Sillery Cove before it was floated to the bridge site.

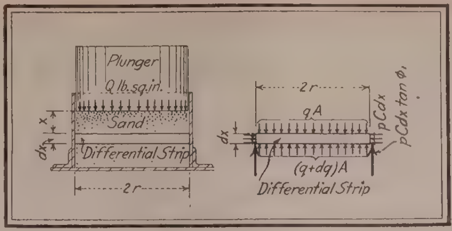
OPERATION OF SAND BOXES

In setting centers on sand boxes allowance must be made not only for their subsequent deflection, either by elevating or cambering the centers, but also for the settlement due to compressibility of the sand. If the sand could be compressed within the cylinder with a force equal to the maximum load to be applied, no allowance need be made for sand settlement, provided, of course, the sand is not subsequently compacted by the continued application of the maximum working load. Uniform preliminary compression of the sand, however, would be a difficult matter, and in practically all cases it is necessary to make allowance for sand compression in placing the centers.

The amount of settlement caused by sand compression should be carefully determined in advance in a testing machine, for it depends on the depth of sand, its quality, the loading pressure per square inch, the ratio of depth to diameter of box, on whether the sand be wet or dry, and to some extent on the length of time required in loading. Plungers should fit into the cylinders with as little clearance as possible to avoid the upward flow of sand between the plungers and inner surfaces of the cylinders, which otherwise will take place even under fairly low pressures.

Either dry or wet sand may be used, although the former flows more readily when the centers are lowered. Wet sand which must be scraped out has the advantage that it cannot flow so quickly, on removal of the plugs, as to get beyond control. It must be remembered, however, that with holes in the sides of the cylinders the flow of dry sand can easily be stopped, even under heavy loads.

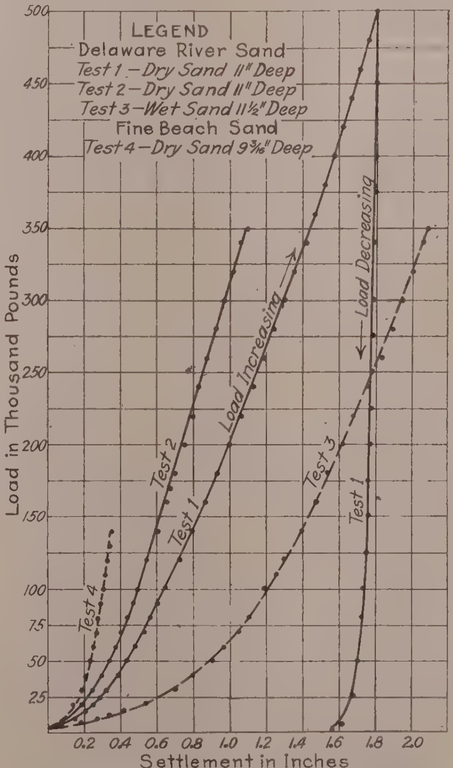
In lowering centers a man at each sand box should be provided with a wrench, a small tin cup for measuring the amount of sand removed, a mallet, and if the sand be wet a scraper will be necessary. At a given signal each man should carefully remove one of the plugs and allow one cupful of sand to run out. The plug should then be screwed back in place and the sand box struck a few blows with the mallet, thus causing the surface of the sand to become level under the plunger. Experiments show that the sand in escaping leaves a depression in the upper surface over the opening. After the foregoing has been done simultaneously for all boxes the process should be repeated until the centers are free from the arch ring.



FORCES ACTING IN SAND BOX

TESTS ON SAND BOXES

Several tests on sand boxes have recently been made in the laboratory at Lehigh University, and the accompanying diagram shows some typical load-compression curves representing results of four tests. In test 1 loading was continuously applied to 500,000 lb. and the compression of the 150 lb. of Delaware River sand, including that of the wooden plunger, was recorded without stopping the testing machine, which was run at a very slow speed. When the load reached 500,000 lb. a wooden plug was withdrawn from a hole in the side of the cylinder and sand was removed until the load reached the initial load. The settlements corresponding to the decreasing loads show that the removal of very small quantities of sand is accompanied by considerable decreases in loads, as would be expected. Forty-four minutes were required to apply the load of 500,000 lb. and only 9 minutes to release it.



LOAD-SETTLEMENT TESTS OF SAND BOXES

In tests 2 and 3 the load was applied to 350,000 lb., on dry sand in test 2, and in test 3 on wet sand which had been shoveled, not rammed, into the cylinder. To release the 350,000 lb. in the dry-sand test with four holes open required 14 minutes, while under the same conditions in the wet-sand test 24 minutes were required to scrape enough sand from the four holes to reduce the load from 350,000 lb. to 109,000 lb., at which the test was discontinued. Some difficulty was experienced in scraping the wet sand out. Delaware River sand used in tests 1, 2 and 3 is very fine and contains small amounts of clay and other foreign matter. In one test with dry Delaware River sand, not here recorded, when the load reached 320,000 lb. a plug in the bottom of the cylinder was forced out and the sand ran out like water from an orifice. All the load instantly dropped off. The cylinder was elevated in this test so that the plug in the bottom could be used.

Test 4 was made on dry beach sand with very small grains of uniform size, and the load was run up to 140,000 lb. only. This sand is less compressible than that used in the first three tests, and it flows very freely upon removal of one plug from the side of the cylinder; but the flow ceases if the sand is allowed to accumulate in front of the opening. At a load of 140,000 lb., or 550 lb. per square inch, the settlements in tests 1, 2, 3 and 4 were 0.8, 0.6, 1.40 and 0.35 in. respectively. Several other tests were made, and they all show that a fine clean beach sand is excellent for use in sand boxes, as it compresses only a small amount and flows freely.

PRESSURE EXERTED BY SAND

The sand pressure against the side of the cylinder tending to rupture the cylinder is an important item in design. The demonstration given herewith is applicable not only to sand boxes but to deep sand bins as well, for in the design of sides and bottoms of bins the pressures are essential, and, clearly, in such cases of a limited mass of earth the usual Rankine theory of earth pressure gives values too large.

The problem may be stated thus: Given a sand box of known depth and diameter, determine the intensities of vertical pressure q and horizontal pressure p at any point. These quantities are given by the formulas:

$$q = \frac{w}{m}\left(1 - \frac{1}{e^{mx}}\right) + \frac{Q}{e^{mx}}$$

$$p = q \tan^2\left(45^\circ - \frac{\phi}{2}\right)$$

In which m is a constant, computed by

$$m = \tan^2\left(45^\circ - \frac{\phi}{2}\right)\frac{C}{A}\tan\phi_1$$

These formulas are derived as follows: Let r, C, and A be the radius, circumference and area respectively of the inside circle of cylinder; w, the weight of sand per cubic inch; ϕ, the angle of repose of sand; ϕ_1, the angle of friction of sand on steel; Q, the vertical pressure from plunger per square inch; q, the intensity of vertical pressure, and p, the intensity of horizontal or bursting pressure at any depth x; e, the base of the Naperian logarithmic system, or 2.718. All dimensions are in inches.

By equating vertical forces on the differential strip, shown in the diagram herewith, and simplifying.

$$dq = dx\left(w - p\frac{C}{A}\tan\phi_1\right)$$

But since in any material without cohesion

$$p = q\tan^2\left(45° - \frac{\phi}{2}\right)$$

there is obtained, after transposing,

$$dx = \frac{dq}{w - qm}$$

Integrating and remembering that the constant of integration may be found when x is 0, because then $q = Q$,

$$x = -\frac{1}{m}\log(w - mq) + \log\frac{w - mQ}{m}$$

From this there results

$$\frac{w - mq}{w - mQ} = \frac{1}{e^{mx}}$$

Therefore

$$q = \frac{w}{m}\left(1 - \frac{1}{e^{mx}}\right) + \frac{Q}{e^{mx}}$$

This gives the intensity of vertical pressure at any depth x, and p, the intensity of horizontal pressure, is then easily computed.

The problem is therefore solved as soon as ϕ and ϕ_1 are determined experimentally.

It is interesting to notice that the first term in the equation for q gives the increase in vertical pressure, as the depth increases, due to the weight of material in the cylinder, while the other term gives the vertical pressure at any point x due to the superimposed load from the plunger. Evidently the latter term decreases with the depth. In an ordinary sand box for arch centers the first of these terms is negligible, but the second is not; whereas for deep sand bins without superimposed loads the reverse is true. The solution given in the foregoing follows somewhat that of a special case given by Morsch in "Der Eisenbetonbau."

Applying the foregoing equations for q and p to a sand box of 9 in. radius; depth of sand, 9 in.; weight of sand, 0.052 lb. per cubic inch; $\phi = 36°$; $\phi_1 = 30°$; $Q = 550$ lb. per square inch, corresponding to 140,000 lb. total load on an 18-in. plunger, there results: $e^{mx} = 1.35$; at the top of sand, $q = 550$ and $p = 143$; at the bottom, $q = 408$ and $p = 106$.

With p known it is a very simple matter to compute the thickness of plate required for the cylinder. Assuming a unit tensile stress in the cylindrical plate of 16,000 lb. per square inch and an efficiency of its vertical seam of 50 per cent, t, the thickness of the plate in inches, is $rp/8000$.

Causes of Low Break

The following table, taken from a report by H. E. Breed on the progress of New York highways, refers to causes of low break as determined in the state's road-testing laboratory:

	Per Cent
Sand, dirty, containing loam and also dirt from subgrade	35.4
Stone or gravel, coated	35.0
Sand, too fine	8.5
Poor quality of stone or gravel	8.2
Poor manipulation in making cubes	4.7
Lack of proper mixing	3.5
Miscellaneous, too wet, etc	4.7

Experiences in Tuning Up St. Louis Filters Indicate What Will Not Work

Brewery Hose and Lead Pipe Are Not Affected by Chlorine or Coagulant Chemicals—High-Rate Wash Does Not Eliminate Mud Balls

A YEAR'S OPERATION of the 160,000,000-gal. filter plant at St. Louis is included in the annual report of E. E. Wall, water commissioner, ending in April. In the detailed report of C. M. Daily, assistant engineer and acting superintendent, is an account of the experiences with chemical pipes, pumps and trial methods of washing that will help in the design and operation of other plants. The following information is from Mr. Daily's report.

The chlorine meters and dissolving towers, which are placed on the second floor of the headhouse, were connected by 1½-in. hard-rubber pipe to a 4-in. vitrified clay pipe laid in concrete (having a minimum thickness of 3½ in. around the tile), running from the outside wall of the building to the drawing conduit chamber. Along the north wall of the chamber the vitrified clay pipe, incased in concrete, was supported by two 8-in. I-beams. Three 2-in. brewery hose from this pipe projected a few feet below the surface of the water. On starting, leaks occurred at the connections of the rubber pipe to the vitrified pipe and were repaired with litharge. In a few days leaks developed all along the vitrified pipe, which was about 3 ft. below the surface of the ground, scarcely any of the chlorine water reaching the drawing conduit chamber. Repairing this line seemed useless, as the concrete was rotten where the chlorine water came in contact with it. A 2-in. brewery hose was run through the 4-in. vitrified clay pipe, couplings being made with hard-rubber pipe and litharge, and no further trouble has been experienced with this line.

The strength of the aluminum-sulphate solution used varies from 1 to 3 per cent. From the solution tanks in the headhouse the solution is pumped into orifice boxes, two at the south end of the filter house and five at the north end. The chemical lines at first were three in number, two flow and one return, made of 8-in. vitrified clay pipe, surrounded by concrete of a minimum thickness outside the pipe of 3-in., and 4-in. fiber-pipe connections to the orifice boxes and meters, and from them to the point of application.

ALUM LINES LEAK

When these lines were tested, about April 20, 1915, leaks developed to such an extent along the entire length of approximately 850 ft. that when pumping was at the rate of 200 gal. per minute none of the water reached the orifice boxes, which were about 30 ft. above the lowest part of the line and 15 ft. above the level of the solution in the tanks. Repairs were made by cutting out the concrete and replacing it with new concrete. A retest made about a week later developed new leaks under the groined arches and also under the floor of the headhouse. The floor was torn up, the pipe removed and a sub-base of concrete 5 in. thick laid, on which the 8-in. vitrified pipes were placed, the joints being well calked with oakum and plastered with cement mortar and then surrounded with 3 in. of concrete. After repairing the new leaks under the groined arches, a retest was made and only about one-half of the water pumped reached the orifice boxes at the north end of the filter plant. Other portions of the line were removed and replaced as in the headhouse, and with the entire line repaired a final test was made about May 10. After 6 hours water was noticed coming through the floor of the headhouse from leaks in the relaid pipe, and with numerous small leaks all along the line. It was then decided to abandon the entire vitrified clay-concrete line.

A 2½-in. firehose was used as a temporary line from the pumps in the headhouse to the 4-in. fiber connecting line at the orifice boxes at the south end of the plant, and the first chemicals were added to the influent flume May 20. The fiber line broke the first day in use while under a head of less than 15 ft. The broken section was replaced and additional braces and anchors were installed, but the pipe became soft and the liquid oozed through the walls, the pipe breaking many times.

About July 7 it became necessary to add aluminum sulphite in larger quantities than was advisable in the influent flume, and the hoppers beneath the orifice boxes at the north end of the plant were provided with a grating and the dry aluminum sulphate was brought in in trucks and emptied into them, water from a ¾-in. pipe sprayed over the chemical and the solution run through the 4-in. fiber lines to the point of application at the Venturi meters outside the building. The 4-in. fiber pipe lasted about two days, being repaired several times, and was replaced with 2½-in. hose until lead pipe could be installed.

LEAD PIPE HOLDS

The replacement of the 8-in. vitrified clay, the 4-in. fiber and the temporary hose lines by 4-in. 8-lb. lead pipe in 20-ft. lengths—the lengths being connected by cast-iron flanges through which the pipe had been run—was started as soon as the pipe could be obtained. In the filter house the new lines were laid on the effluent or clear-water conduit between the washwater line and the pressure line. In the headhouse the new lines were run through the 8-in. clay pipe. Two lines were completed July 31 and the third one was laid in February. The cost of the original piping was $1,300, and of the new piping complete in place, $2,309.05.

The chemical pumps (3-in.) made of Vanadium Victor Silver metals, as specified by the city, are corroded by the aluminum sulphate solution to such an extent that new labyrinth rings are now necessary and the impeller wheel is slightly reduced in thickness. The capacity has also been reduced over 20 per cent, but the replacement of the labyrinth rings may overcome the loss of capacity to a great extent.

The automatic chemical-feed controllers have worked very successfully, the only trouble being that the brushes on the small motors, made of woven wire, cut the commutators and have had to be replaced with carbon brushes. The master controller and indicator were installed in 1915 and are working satisfactorily. The controllers work very satisfactorily, requiring no special care or attention.

The first test was to determine how much filtered water should be wasted after washing. The turbidity of the effluent was measured every 3 minutes at various rates of filtration without wasting any of the effluent, and it was found that the 500,000-gal. rate, the lowest at which it was possible to control, gave the best results. (Each filter has a capacity of 4,000,000 gal. daily when run at a rate of 125,000,000 gal. daily per acre.) Running at the low rate the first effluent was clear, became turbid for a time, and then became clear again. A probable average was 5000 gal. of clear water and more than 18,000 gal. turbid. Dry aluminum sulphate was added to the water in the central gutter when filling the bed after washing; 1, 2 and 3 gr. per gallon for the quantity of water above the sand amounting to 7, 14 and 21 lb. per bed were tried. Fourteen pounds gave the best result.

Amount of Aluminum Sulphate

Adding 14 lb., the turbidity during the turbid period seldom exceeds 1 part per 1,000,000, and is often as low as ¼ part per 1,000,000, the average amount of effluent running clear immediately after washing being about 4500 gal., and the turbid amount equaling 11,000 gal. The time after washing until running clear varied from 40 to 50 minutes, and after this time the rate could be raised to any amount up to 5,000,000 gal. daily, the highest rate run up to this time, the effluent remaining clear. The immediate increase in the loss of head after raising the rate varied 1 to 3.5 ft. As a result of these experiments 14 lb. of dry aluminum sulphate is put in the central gutter as the bed is filling after washing, no effluent is wasted and the filter is run for 1 hour at the 500,000-gal. rate and then raised to the required rate.

Another problem was the quantity of water to be used for washing the filter and the rate at which washing was to be done. At first the rate of washing was limited to 18 in. per minute vertical rise, the washing being continued until clear patches of water appeared on the surface. It was observed that a smaller amount of water was used per wash at the highest rates to accomplish the same results. The rate was gradually increased until now a maximum rate of 24 in. is allowed.

Cannot Wash Out Mud Balls

It has been noticed that after a period in which the turbidity of the influent is low and there is very little flock in the water, during which the time between washings increases in some cases to 105 hours, the film would become very hard to break up, and the formation of mud balls, which are found in the sand varying in size from ⅛ to ¾ in. in diameter, mostly of the smaller size, was increased. It is very difficult to dissolve these balls, and screening them out while washing is now being tried with ¼ an ½-in. mesh screens. The results are encouraging. The mud balls cannot be washed out, even at a 28 to 30-in. rate.

One strainer plate only was found split after a high-rate wash.

The rate of washing as developed thus far is from 3 to 6 in. per minute until the bed is broken. Then the rate is raised from 21 to 24 in. per minute and continued until clear patches of water cover about half of the bed.

For a study of the sand in washing a device was constructed for collecting samples of the sand at various depths simultaneously, consisting of fifteen telescoping copper cans, 3 in. in diameter and 3 in. high, provided with ¼ x ¾-in. openings near the top, covered with rubber slip valves, each can having an air vent projecting above the water when submerged. The cans, fastened on a frame, are lowered into the sand while washing, and, all the slip valves being removed at once, a good sample (nearly two-thirds of a canful) can be obtained at the various depths. These samples indicated a close grading of the sand and the location of the mud balls.

Screw Spikes for New York Connecting Railroad

Standard Pennsylvania 125-Pound Rail Is Being Laid, with Supported Joints and Six Spikes to Each Tie Plate

Six screw spikes to each tie plate are being used in the track of the New York Connecting Railroad, which is expected to be put in service in January. Each plate has three projecting shoulders as shown, the small one to align the plate with the rail base, the two larger ones to give support to the spike head. Four ¾-in. spikes hold the plate to the tie, and two ⅞-in. spikes hold the rail. The Pennsylvania standard 125-lb. rail is being used, with four-bolt supported joints. The spike holes in the joint plates are normal to the slope of the base to give an even bearing.

The track details were designed and the track is being laid under the direction of A. C. Shand, chief engineer of the Pennsylvania Railroad.

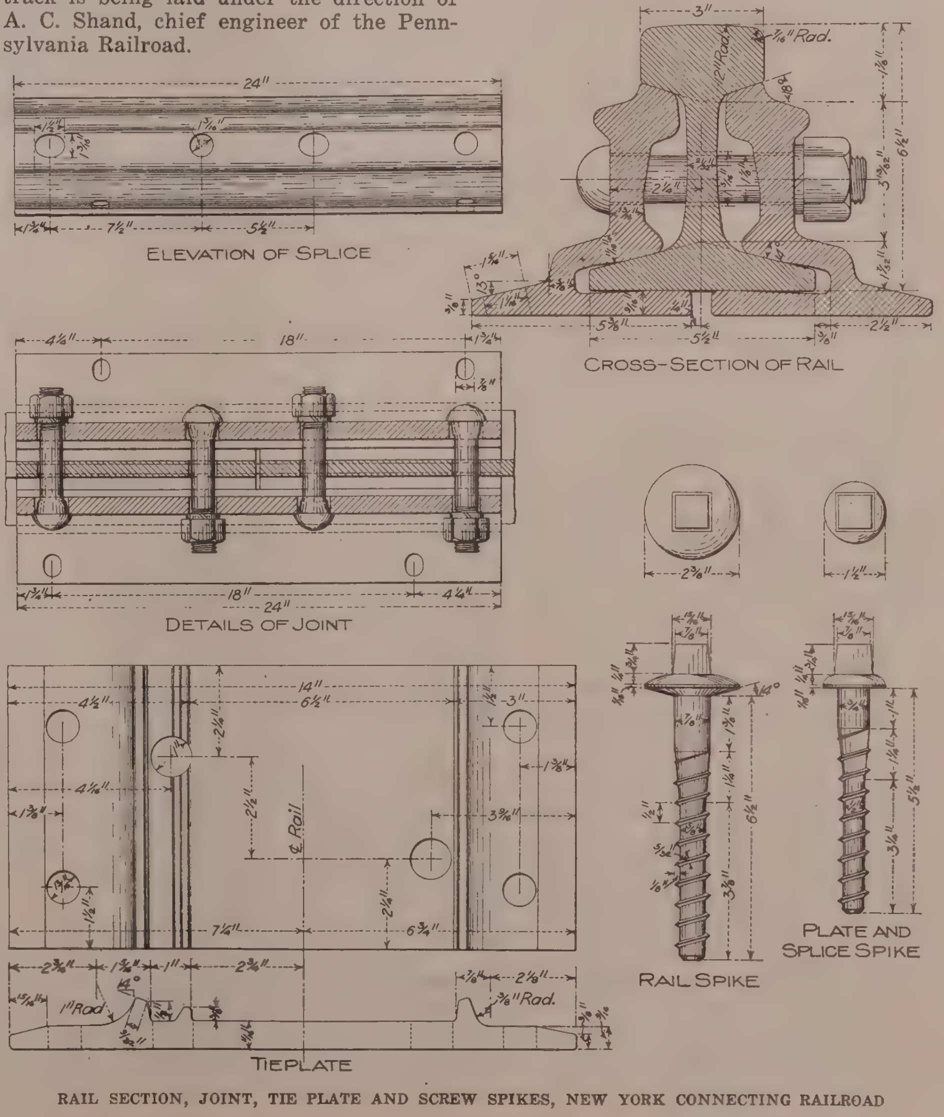
Highway Commission Wants Results, Not Excuses

Instruction Sheets to Inspectors Succinctly Tell What Must Be Done and How to Accomplish Vital Features

"Remember, we want results, not excuses." This is the starting and ending slogan in the instructions for inspectors of concrete roads on state highway work in Outagamie County, Wisconsin. Other things which the inspector must do are set forth in succinct, epigrammatic form.

"Accomplish two things—first, well-executed work; and, second, the co-operation of the people in the community where you are working. One is as important as the other. Therefore you must attend strictly to business at all times, start work promptly every morning when the contractor does and remain on the job as long as he is doing any work, or until the last section of concrete laid is floated. You are expected to stay on the job all the time except during inclement weather. Intoxicating liquor in any form is prohibited on state-road work. Inspectors must keep out of saloons during working hours.

"You should be thoroughly familiar with the plans and specifications. It is not necessary for the contractor to complete the subgrade and ditches the full width before he hauls his materials, but he should have a subgrade completed about 22 ft. wide, perfectly flat and well rolled. The center



RAIL SECTION, JOINT, TIE PLATE AND SCREW SPIKES, NEW YORK CONNECTING RAILROAD line should be staked out at least 1000 ft. ahead of the materials to see if there are any errors in alignment.

Accuracy Essential

"The contractor should have a straight edge and carpenter's level on the job. The straight edge should be at least a foot longer than the width of the concrete pavement. Check the form crosswise with the straight edge a few feet ahead of the mixer. When the straight edge is level, subgrade should be 6 in. deep. See that the subgrade is level, and not 7 in. deep in one place and 6½ in. in another place, and so on. We want exactly what the contract calls for.

"See that all contract materials are clean and that the shovelers do not shovel dirt from the subgrade in with the sand and stone. Check the contents of the wheelbarrows by means of a box that will contain 1 cu. ft. of materials. When the materials are dumped from the hopper into the mixer, see that the materials remain in the mixer at least one minute before being discharged. Don't accept a wet, sloppy concrete.

Setting of Joints

"Joints should be set as directed in the specifications. They should be set vertical and should extend to the bottom of the pavement, and should be wide enough so that they will be at least ½ in. above the center of the pavement. The edger should be run along both sides of the joint and along the forms. The subgrade should be kept sprinkled before the concrete is discharged from the mixer.

"The strike board should be cut to a curve and should be at least 18 in. longer than the width of the pavement, and should have an iron shoe on the under side. Check the strike board to see if it has the right crown at the center before using it. The strike board should be run over the concrete about three times and not over five times, to get the right amount of finish. Too much striking brings too much fine material to the top. The floating should be done by a man working from a bridge, on his knees. The concrete should not be floated when too wet.

"The pavement should be covered with an earth covering as soon as hard, and should be kept wet for at least two weeks. Keep all travel off for thirty days. See that both ends of the road are well blocked so that nobody can drive in. Each day's concrete should be protected at night with woven wire to keep dogs and chickens from getting on it while it is wet. Keep track of the cement as it arrives on the job.

"Finally, remember we want results, not excuses."

Gasoline Output Grows

Vast increase in the production of raw gasoline from natural gas resulted from expansion of the casing-head gasoline industry during the last calendar year. The U. S. Geological Survey recently announced that 65,364,665 gal. of raw gasoline was extracted and sold during the year. That was a gain of 22,712,033 gal., or 53 per cent, over 1914. An average price of 7.9 cents a gallon for the unblended product was received at sources of production, and the entire market value of the year's output was $5,150,823—a gain of $2,044,914 over 1914. It is estimated that 24,000,000,000 cu. ft. of natural gas was utilized in the manufacture, with the average recovery 2.57 gal. of gasoline per 1000 ft.

Puddling and Rolling to Assure Impervious Foundation for Keechelus Reservoir

Embankment Carefully Constructed to Make Watertight Connection—Piling Displaces Concrete Core in Water-Bearing Gravel

By C. E. CROWNOVER

Construction Engineer, U. S. Reclamation Service, Meadow Creek, Washington

IN THE DESIGN of Keechelus reservoir on the Yakima River in Washington every possible precaution was observed to make the dam watertight. The aim has been to discourage, so far as possible, the entrance of water either into the embankment or under it. Should seepage reach the lower side of the core wall, provision has been made to prevent saturation of either embankment or foundation and to drain away any water that may not have been intercepted. Particular care has been taken in the construction to prevent seepage along the wall of the conduit.

As noted in the discussion of the design in the Engineering Record of Oct. 14, page 474, it was found more economical at the river section to place the core wall in a deep, narrow trench. The position of the wall with reference to the cross-section of the dam was shown in the issue mentioned.

THE LOWER END OF THE OUTLET CHANNEL WAS EXCAVATED WITH A DRAGLINE EXCAVATOR; THE LAKE END WITH A DIPPER DREDGE. SPOIL WAS CARRIED AWAY BY 50-YARD CENTER-DUMP SCOWS AND DEPOSITED BELOW LOWEST RESERVOIR ELEVATION

Because of the large amount of water encountered at the south end of the dam in passing through a stratum of water-bearing gravel, 9 x 12-in. Wakefield piling of Douglas fir was used instead of concrete. This core wall or break—it is just an obstruction to discourage the travel of water between the natural ground and the constructed embankment—was thoroughly puddled in by hand with earth for a depth of about 2 ft. above its top or until it was possible to go upon the puddle with teams and steam roller after settling. It was then carried up in rolled layers, the whole becoming an integral part of the rolled portion of the embankment.

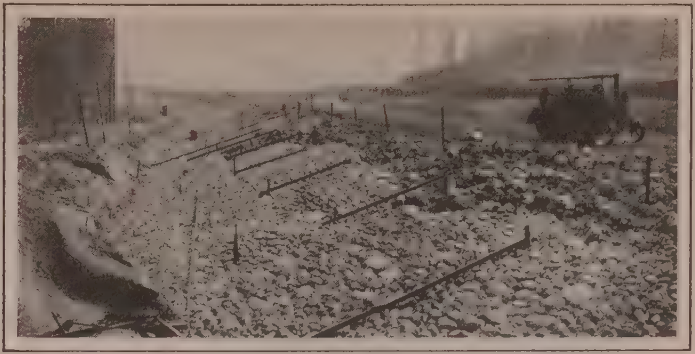
Across the river section and well into the banks on either side, the core wall extends 25 ft. below outlet conduit grade and up into the embankment to a height of 20 ft. above the top of the conduit. The portion below grade is 4 ft. thick, but from this point narrows up to 18 in. at the top.

Core Wall in Impervious Clay

The core wall for its entire length is founded on gravelly clay that is practically impervious. At a depth of 31 ft. below outlet conduit grade, or 6 ft. below the bottom of the core wall in the river section, test holes disclosed a fine sand under much pressure. This sand formation is of considerable depth and test holes were driven for a depth of 35 ft. without passing through. It was considered too deep to pass through with a cutoff, and the core wall was therefore founded well above in impervious material. A series of wash drill holes was driven along the conduit line within the dam prism and the heights to which the water rose in them observed. No relation seemed to exist with the height of the water in the lake above the dam. The bed of the lake was thoroughly explored by drill holes for a considerable area in front of the dam and for a depth of 40 ft. below gate-sill elevation. It was found to be covered with from 5 to 20 ft. of blue ooze overlying a very tight gravelly clay of great depth. For 1700 ft. farther out in the lake the same blue ooze was found, but no apparatus was available to bore below it in such deep water. It is therefore quite certain that an impervious mud blanket covers the lake bottom, effectively cutting off any connection of the lake water with that found in the sand strata below the dam.

Assume for the sake of argument that the water-bearing strata did connect with the lake at a point 40 ft. below gate-sill elevation, or the farthest point out at which definite soundings were made. Then with full reservoir the water pressure would be equivalent to a 96-ft. head, while the total distance from the point of intersection to the downstream toe of the dam is 1600 ft., giving an average gradient of 1:16.6. The point of intersection of the water-bearing strata on which the foregoing assumption is based is definitely known to be much farther out in the lake if it exists at all. Hence it is believed positively certain that there can be no danger of piping or leakage water with the full reservoir exerting an upward pressure on the material forming the foundation of the dam. For additional safety, however, the conduit was extended 35 ft. beyond the bottom of the 2:1 slope and blanketed with sand and gravel. This extension was also desirable in that it removed the stilling pool away from the toe of the main embankment.

The embankment consists of 522,000 cu. yd. of material, one-third of which is gravel on the lower side and two-thirds fine se-



LEFT, CONDUIT UNDER CONSTRUCTION—RIGHT, EMBANKMENT GIVEN NOT LESS THAN SIX IMPRESSIONS WITH 12-TON TRACTOR

lected rolled material on the water side. The gravel portion was dumped, spread and rolled over the higher sections. The low fills were dumped directly into place. This material was of a consistency that will not slough under saturation. A rock-filled drain extends the entire length of the dam, just under the lower toe. On fills of 20 ft. or more a 12-in. tile drain with open joints was placed in the gravel section, with outlet drains to the toe trench at all low points. Both of these features were shown on the section at Station 15 in the Oct. 14 issue.

ROLLING WATERTIGHT PART OF DAM

The fine material forming the watertight portion of the dam was spread in 6 to 8 in. horizontal layers, sprinkled and given not less than six impressions with a 12-ton traction engine giving about 300 lb. pressure per inch of tread of rear wheels. The rolling was done in two directions, with a roller having two separated wheels, tending to avoid continuous jointing in planes. As the material was spread and before rolling, all rocks 4½ in. in longest dimension were picked out and particular care taken to insure that the smaller rocks remaining were well distributed.

As this portion of the embankment was being built test pits were dug at intervals of about 200 ft. and so located as to give a continuous record from the original ground surface to the top of the dam. A classification of each pit was made and particular attention given to stratification, cleavage along horizontal planes, amount of moisture, etc. The pits were then filled with water and seepage observations made. Mechanical analysis and silt tests were also made from samples taken from the test pits. The former showed that about 28 per cent of the material passing a No. 4 sieve would pass a No. 100 sieve. The silt tests disclosed the fact that about 25 per cent of that passing a No. 4 sieve was silt. The remainder of the material was of a gravelly nature and well graduated.

A surfaced roadway will be built across the top of the dam connecting the transcontinental line of the Chicago, Milwaukee & St. Paul Railway with the Sunset Highway leading across the Cascade Mountains through Snoqualmie Pass to Seattle and other Puget Sound points.

CONSTRUCTION PLANTS

Electric power is delivered to the construction work at Keechelus dam over a 2200-volt transmission line 1¾ miles long and transformed to 110 or 220 volts as required. The waterpower plant has a working head of 280 ft. obtained by 2000 ft. of wooden flume and a 24-in. wooden penstock 1000 ft. long. The powerhouse equipment consists of two 200-hp. turbines, two 120-kw. 2300-volt three-phase 60-cycle alternating-current generators, each direct-connected to turbines, two Lombard oil-pressure governors for turbines and one three-panel switchboard.

The rock crusher, sand rolls, revolving screens, concrete mixers, pumps, sawmill and repair shop, and all other machinery are operated by motors. The heavy equipment—steam shovel, dragline excavators, embankment rollers and dipper dredge—is steam-operated.

CONSTRUCTION METHODS

After clearing the dam site all stumps larger than 12 in. in diameter were loosened with stumping powder, pulled and piled with a logging donkey, and burned. Two feet of the top soil was then removed by plowing and by using teams with slips, fresnos and scrapers. The cutoff trench was excavated with a 1½-cu. yd. Lidgerwood Crawford dragline excavator. The core-wall trench was dug by hand and the concrete hauled by train from the mixing plant and chuted to the forms. The backfill of the cutoff trench was thoroughly puddled in by hand up to 2 ft. above the top of the core wall. The remainder was placed with teams, spread and rolled.

A 2-ft. gage railroad extends the entire length of the dam on which all material for the embankment, except the river section, is brought in by trains of 12½-cu. yd. cars hauled by 9-ton locomotives. After being dumped the material is spread with fresnos into 6-in. layers and rolled with a Buffalo-Pitts steam roller. Riprap and foundation rock are brought to the dam in the same manner and placed by hand. Material for the river section is hauled in on the lower elevations by 2-cu. yd. three-horse dump wagons, dumped where needed and spread with fresnos before rolling.

CORE WALL PLACED IN BOTTOM OF TRENCH

The lower end of the outlet channel was excavated with a dragline excavator, while the lake end was dredged with a 1½-cu. yd. Fairbanks dipper dredge. The spoil was towed by gasoline launches to the lake in 50-cu. yd. center-dump scows and dumped below lowest reservoir elevation.

CONCRETE-HANDLING METHODS

Rock excavated for the spillway is used for riprap and crushed for concrete. From the crusher both stone and sand are hauled by train to the mixing plant, where they are dumped into storage bins. From the bottom of the bins they pass by gravity through measuring devices into a hopper where the cement is added. After being mixed in a 1-cu. yd. Ransome mixer the concrete flows into a Lakewood automatic tilting concrete hoist bucket and is again hoisted to the track. From there the aggregate is dumped, chuted into concrete cars and transported by trains for use in the core wall. The mixing plant was so located that the concrete was handled direct to the river conduit and gate tower by chuting direct to forms or pushing for short distances in concrete cars. For the spillway concrete a mixer will be installed near the crushing plant.

Work was begun in the spring of 1913 and will be completed, with the exception of a portion of the clearing, during the present season. The work is located only eight miles from the summit of the Cascade Mountains in the region of deep winter snows. It has therefore been necessary entirely to close down each winter for four or five months. During the short season work is prosecuted vigorously, both night and day, with a force of from 500 to 700 men.

COMPLETE CONSTRUCTION CREWS ORGANIZED

On work of this character, where unknown conditions require frequent change of plants, where classification of material is particularly difficult, and the working season short, it has been found that it can be done much more satisfactorily with government forces than by contract. It was therefore necessary to organize complete construction crews, as well as an engineering and supervisory force. The construction department assumes the position of a contractor and is required to execute all work under rigid inspection of the engineering department.

As noted in the Oct. 14 issue, the work is under the general direction of the U. S. Reclamation Service, of which A. P. Davis is director and chief engineer. Until July, 1915, the work was under the administrative supervision of G. H. Swigart, supervising engineer of the Washington division. Later, S. B. Williamson, chief of construction, had supervision. The writer is in direct charge of construction on the Yakima storage project, assisted by R. E. Post, superintendent of construction, and J. R. Sherman, assistant engineer.

Rules Proposed to Control Motor Trucks in Jersey

Tentative Schedule of Restrictions on Size, Weight and Speed Suggested as Forerunner of Legislation

As a preliminary to legislation regulating the weight, size and speed of motor trucks in New Jersey a special committee, appointed by William L. Dill, state commissioner of motor vehicles, has submitted a tentative set of rules placing certain restrictions upon this type of traffic. The rules have been formulated, of course, to protect the state's highways from unreasonable use. In their present form, however, they are considered too drastic by the Motor Truck Club of America, whose counsel, Charles G. Bond, of the firm of Coulter & Bond, at a meeting of the club in New York City Oct. 18, presented the case of the motor-truck interests, outlining the results of his conferences with the New Jersey committee and calling upon members of the Motor Truck Club to express their views regarding the proposed legislation. A summary of the New Jersey rules, which are subject to change before final adoption, is given below and the objections of the motor-truck interests are discussed in an editorial on page 519.

REPORT OF NEW JERSEY COMMITTEE

The special committee appointed by William L. Dill, commissioner of motor vehicles of the State of New Jersey, on May 4, 1916, for the purpose of preparing rules and regulations to govern the use of motor vehicles or trucks on the highways of the State of New Jersey, submits the following:

1. No commercial vehicle or truck of over 4000 lb. weight shall be more than 96 in. in width, outside measurements, except that in extreme cases the commissioner of motor vehicles shall be privileged to issue permits for the operation of motor vehicles or trucks with a width of load over 96 in. where the weight of the load is not a factor.

2. No commercial vehicle or truck shall be equipped with metal tires that may be in contact with the surface of the road, nor shall any such vehicle or truck be equipped with any tires which have a partial contact of the metal with the surface of the road.

3. No commercial vehicle or truck shall be equipped with any tire covering of metal, or with any lugs or hobs, or other sharp devices which would be in contact with the surface of the road, except chains which may be used in accordance with the Motor Vehicle Act.

4. The height of all commercial vehicles or trucks shall be limited to 12 ft. 2 in.

5. All commercial vehicles or trucks should be equipped with a sealed governor, the speed to be regulated as per schedule attached hereto.

6. No commercial vehicle or truck shall be equipped with center searchlight, but that the lights of all commercial vehicles or trucks shall be in conformity with Section 4 of the Motor Vehicle Act.

SCHEDULE SHOWING ANNUAL FEE AND FEE IN SEPTEMBER, BASED ON GROSS WEIGHT

Gross weight of truck and carrying capacity, pounds	Annual fee	Fee in September
4,000 or less	$15.00	$7.50
4,000 to 5,000	17.50	8.75
5,000 to 6,000	20.00	10.00
6,000 to 7,000	22.50	11.25
7,000 to 8,000	25.00	12.50
8,000 to 9,000	27.50	13.75
9,000 to 10,000	30.00	15.00
10,000 to 11,000	32.50	16.25
11,000 to 12,000	35.00	17.50
12,000 to 13,000	40.00	20.00
13,000 to 14,000	45.00	22.50
14,000 to 15,000	50.00	25.00
15,000 to 16,000	55.00	27.50
16,000 to 17,000	60.00	30.00
17,000 to 18,000	65.00	32.50
18,000 to 19,000	70.00	35.00
19,000 to 20,000	75.00	37.50
20,000 to 21,000	81.25	40.63
21,000 to 22,000	87.50	43.75
22,000 to 23,000	93.75	46.88
23,000 to 24,000	100.00	50.00
24,000 to 25,000	106.25	53.13
25,000 to 26,000	112.50	56.25
26,000 to 27,000	118.75	59.38
27,000	125.00	62.50

7. The extreme length of motor vehicles or trucks shall not exceed 23 ft. 6 in.

8. Not more than one trailer shall be allowed to any commercial vehicle or truck; in every case said trailer shall be equipped with rubber tires.

9. All commercial vehicles or trucks shall carry a spare wheel, so as to avoid the possibility of any part of the steel rims coming into contact with the surface of the road, should the rubber tires become broken or otherwise damaged.

10. All drivers of commercial vehicles or trucks shall carry way bills for each load, said way bills to show the gross weight and net weight carried.

11. The commercial size of tires used on all commercial vehicles or trucks shall be determined on the maximum width of rubber.

12. All license fees shall be based on the maximum wheel load carried on same, said wheel load to be determined by the size of tire used and adopted in conformity with the schedule hereto attached.

PROPOSED SCHEDULE OF LOADS, SPEEDS, TIRE WIDTHS AND DIAMETERS

Tire size, inches		Wheel diameter, inches 32	34	36	38	40	42	Speed, miles per hour
		Maximum wheel load in pounds						
2	Single	565	595	625	660	690	720	20
2½	Single	840	890	940	990	1,040	1,090	20
3	Single	1,125	1,190	1,250	1,315	1,375	1,440	20
3½	Single	1,415	1,490	1,565	1,640	1,715	1,790	18
4	Single	1,690	1,780	1,875	1,970	2,065	2,155	16
5	Single	2,250	2,375	2,500	2,625	2,750	2,875	14
6	Single	2,815	2,970	3,125	3,285	3,440	3,595	12
7	Single	3,375	3,565	3,750	3,940	4,125	4,315	10
2	Double	1,125	1,188	1,250	1,312	1,375	1,438	18
2½	Double	1,675	1,775	1,875	1,975	2,075	2,175	18
3	Double	2,250	2,375	2,500	2,625	2,750	2,875	16
3½	Double	2,825	2,975	3,125	3,275	3,425	3,575	14
4	Double	3,375	3,560	3,750	3,940	4,125	4,310	13
5	Double	4,500	4,750	5,000	5,250	5,500	5,750	12
6	Double	5,625	5,940	6,250	6,565	6,875	7,190	10
7	Double	6,750	7,125	7,500	7,875	8,250	8,625	10

13. All trailers or semi-trailers shall be licensed on their carrying capacity.

14. All counties in the state shall place signs showing the clearance on all bridges in their respective counties, if the clear headroom is less than 12 ft. 6 in.

15. A special permit shall be secured from the state motor vehicle commissioner for the use of trucks as pleasure vehicles.

16. The trucks or commercial vehicles equipped with under-sized tires shall not be licensed.

17. On each rear wheel one-third of the gross weight of truck and carrying capacity combined must be within the limits of the schedule of the respective diameter of wheel, size of tire and speed in miles per hour as shown in schedule hereto attached.

18. The front axle shall carry the balance of the gross weight of truck and load combined and must be within the limits of the schedule of the respective diameter of wheel, size of tire and speed in miles per hour for single tires, as shown by the schedule hereto attached.

19. All commercial vehicles or trucks carrying any load extending beyond the sides or ends of the outside dimensions of said vehicles or trucks shall have displayed at the outside extremity of load a red flag which shall be not less than 12 in. square and shall be so long as to present a full view to approaching vehicles.

The committee submitting this report consisted of Thomas J. Wasser, chairman; John J. Albertson, Garwood Ferguson, Alvin Fox, and Frederic A. Reimer, secretary.

$18,000,000 Worth of Highways Accounted For

Review Made of Costs and Notable Features of California Commission's Work Since 1909

With the expenditure of the last of the $18,000,000 which was authorized in California in 1909 for the construction of trunk highways, the highway commission has been able to show a road system laid out in complete detail with finished roads in every part of the state on those routes where the immediate need was the most urgent. The aggregate mileage completed includes 966 miles of oil-surfaced concrete pavement, 129 miles of oiled macadam and 395 miles of graded dirt road.

COSTS SUMMARIZED

A review of the costs and notable features of the work accomplished by the commission, from which the following has been taken, was recently prepared for the California Automobile Association by Eric Wold, who was retained for that purpose. His résumé of the commission's statement of expenses shows the following figures:

Construction cost:	
Payments on contracts, materials and day labor work	$14,284,552.11
Equipment (1.15 per cent of construction cost):	
Expenditures of all classes of equipment and furniture	164,394.46
Expenses (16.64 per cent of construction cost):	
Expenditures for engineering, legal accounting, purchasing, laboratory, services and expenses incidental thereto	2,372,757.41
Total expenditure to June 15, 1916	$16,821,703.98
Total amount available from state highway fund	18,000,000.00
Unexpended balance June 15, 1916	$1,178,296.02

Since June 15, 1916, at which time the foregoing figures were brought up to date, the commission has obligated itself for the expenditure of approximately the entire balance remaining out of the original $18,000,000.

A general survey of 175 contracts under which the commission has let highway construction work developed the following average prices, which include the cost of material:

Excavation, including clearing right-of-way, shaping and finishing of roadbed, watering and rolling, per cu. yd.	$0.41
4-in. concrete pavement, per sq. yd.	.738
1½-in. asphalt wearing surface, per sq. yd.	.45
⅝-in. oil top, per sq. yd.	.054

A total of 2350 miles of road was surveyed at a cost of $744,957, or $317 per mile. Of this total only 1490 miles have been constructed, as before stated, so that the cost of locating ready for construction about 860 miles of highway is included in the expenditures made to date. This mileage of survey on which construction was not undertaken was necessary because of the difficulty and delay in securing certain necessary rights-of-way which forced the commission to construct disconnected lengths of road.

The handling and delivery of all materials used on construction were undertaken by the commission, and the overhead charge of 10 to 20 per cent of the net cost of the contract, which is usually allowed for this item, was borne by the commission and is included in the commission's expenses. A summary of the equipment which the commission purchased to carry on this work is as follows:

CALIFORNIA ROAD-BUILDING EQUIPMENT

Equipment	Cost	Per cent salvage	Salvage
Sand plants	$27,259.19	100	$27,259.19
Construction equipment	21,257.49	100	21,257.49
Engineering equipment	25,716.10	50	12,858.05
Furniture	21,328.05	40	8,531.22
Stable	17,070.99	100	17,070.99
Auto	41,380.55	40	16,552.22
Camp	6,429.32	20	1,285.87
Laboratory	3,952.74	50	1,976.35
	$164,394.43		$106,791.38

Therefore the 17.79 per cent of the total expenditure, which is shown in the first table as gross overhead, includes in reality salvable equipment, surveys (the advantage of which has not yet been realized), and other minor items, such as designs, supervision, etc., given gratis to counties undertaking independent road work. The net overhead chargeable to the construction work on the roads actually built, including allowance for these items, amounts to 12.75 per cent of the gross construction costs, which is considered a very reasonable allowance for net overhead on public work of this character.

FOUR NOTABLE FEATURES

Four notable features of the construction work are pointed out as follows: (1) The construction of the Ridge Route road from Los Angeles to Bakersfield (described in the Engineering Record of Sept. 11, 1915, page 322), which shortened the distance between these two cities 25 miles and afforded a maximum gradient of 6 per cent, as compared to the 20 per cent gradient of the older routes; (2) the construction of the new San José-Salinas route, which eliminated the dangerous San Juan grade; (3) the elimination of the Bell Springs grade on the Mendocino-Humboldt line, which reduced the maximum grade from 30 to 6 per cent and eliminated 2686 ft. of rise and fall; (4) the construction of the Yolo Causeway (described in the Engineering Record of Aug. 28, 1915, page 248), which connects both sides of the Sacramento Valley and afforded the first open-all-year crossing in the 200-mile stretch between the Chico bridge and the Benicia ferry.

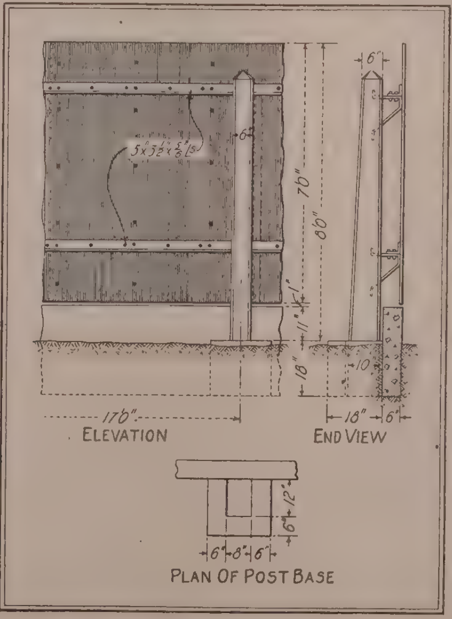
The commission has made surveys and maps of the rights-of-way for the entire length of the highway system. The purchasing department, by developing a system which enabled it to buy in the wholesale markets and distribute to all parts of the work effectively, made a gross saving of $500,000, it is claimed, on purchases and freight reductions. The cost of the legal-department work has been kept down to $30,000, and in all of the right-of-way disputes to be settled there have been no injunction or ejectment proceedings. The commission early established its own test laboratory, where a total of about 5000 tests has been made on the variety of materials used in road construction. The entire expense of the laboratory department, including salaries and the services of an expert geologist, totaled $27,700, which is stated to be about $12,000 less than the cost of having the same tests made by private corporations.

Use Galvanized Corrugated Steel and Concrete Fence

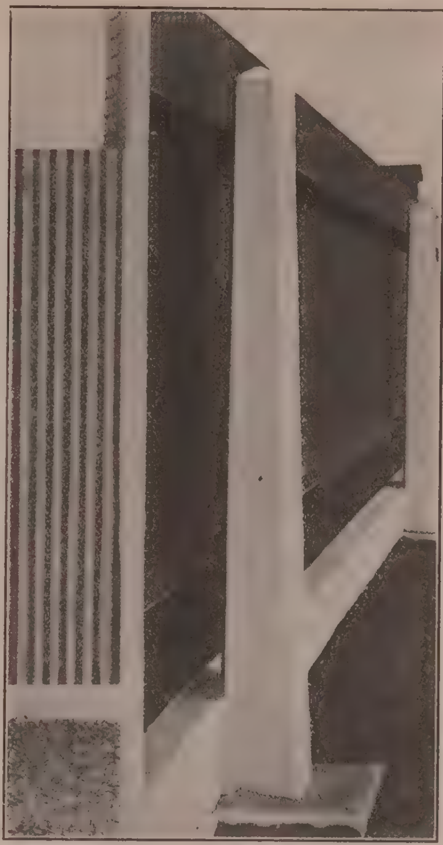
Industrial and Factory Plants and Grounds Protected and Their Appearance Improved by Practically Permanent Inclosure

MANY ADVANTAGES are claimed for the combination type of galvanized corrugated steel fence supported by reinforced-concrete posts which has been used extensively by the American Sheet & Tin Plate Company during recent years. Twelve of this company's plants now use this type of fence, which apparently is highly satisfactory in combining strength and low maintenance cost. The photograph and drawing illustrate the details of these fences.

There are several reasons why this type of fence should be a great improvement over an ordinary wooden fence, especially for industrial and factory plants. It is efficient in prohibiting trespass and in insuring privacy. The concrete curb keeps a constant level in the yard by preventing the soil from washing out, the depreciation is very small and structurally the fence is amply strong to resist high winds and drifting snow.



DETAILS OF CORRUGATED-STEEL FENCE



INSIDE AND OUTSIDE OF TWO SECTIONS

The concrete curbing, 6 in. wide and 29 in. high, placed about 18 in. below the ground level, is made of a 1:3:5 gravel concrete. The post base is cast with the curb, a pocket, shown in the drawing, being left for the post. The posts are of 1:2:4 gravel concrete reinforced by six ¼-in. bars, and are spaced 17 ft. apart. The supports for the longitudinal angles are 3 x ½-in. flats bent as shown and cast in the concrete. These posts are cast as separate units.

The angles for supporting the galvanized corrugated steel are 17 ft. long, set with their 3½-in. legs vertical, and are connected to the sheeting by ¼-in. rivets. Copper-steel sheets 26 in. wide are used, erected 24 in. to the weather, and after six months' exposure are painted.

Meters Save Water for Terre Haute Despite New Consumers

Although there were 500 more consumers of water in Terre Haute in August of this year than during the same month in 1914, the maximum amount pumped was 4,000,000 gal. for any one day during the recent hot period. Two years ago is used for comparison, for a hot spell of similar intensity was encountered. The peak load in 1914 was a 16,000,000-gal. daily rate. This year it was less than 10,000,000 gal. The lowered rate is due to the fact that 93 per cent of the services are metered and the remaining 500 flat-rate payers are small consumers.

Repair Beams and Columns in Concrete Structure

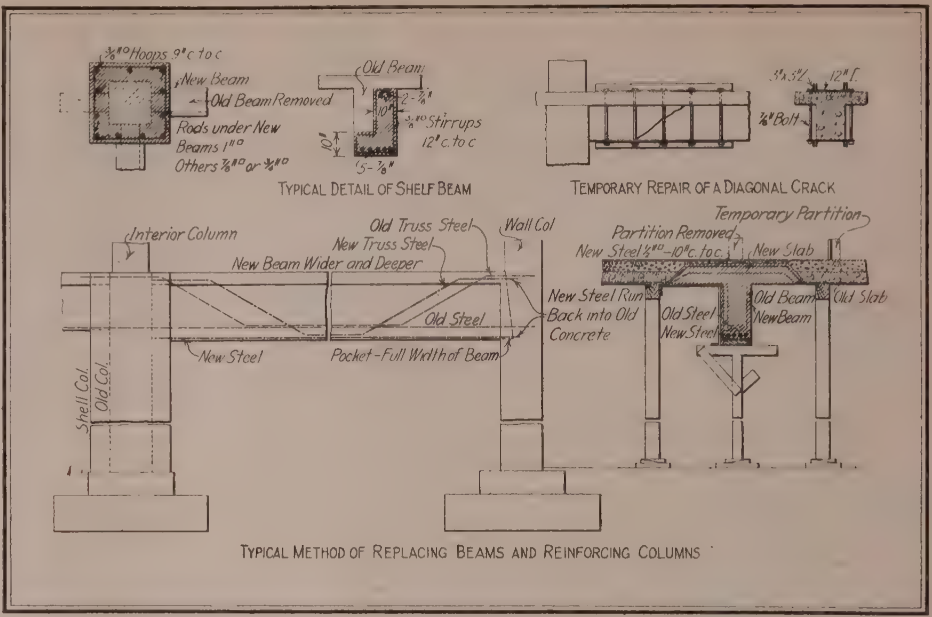
Cracked Floors of Theater Building in Fort Worth, Tex., Strengthened by Addition of Reinforced Concrete

PARTIAL FAILURE of the Majestic Theater and office building in Fort Worth, Tex., evidenced by cracks and sagging in the reinforced-concrete beams and floor slabs, led to the requirement by the building department that the floors be adequately strengthened and repaired. Permission was given to carry on this repair work without removing tenants, so that the unusual problem of constructing envelopes for columns, removing and replacing beams and slabs, and increasing the sections of beams with least inconvenience to tenants was encountered.

NATURE OF CRACKS

The building was constructed in 1910-11, before the city building department was created and before a building code was in force. A trivial accident to an electric sign in 1914 requiring the presence of a building inspector led to the discovery of serious cracks in the floorbeams. Investigation showed many slabs with tension cracks due to negative moments and with large deflections, and a great number of beams badly cracked and sagging. In the latter were tension cracks at the center and diagonal cracks near the quarter points, and in several cases horizontal cracks near the neutral axis running the full length from one diagonal crack to the other. These cracks were by no means microscopic, but were such as appear in laboratory tests upon complete failure. In several columns the concrete had spalled off at the pouring joint and the reinforcing rods at the corners had buckled out. Laitance, dirt and organic matter in columns, from ½ to 3 in. thick, at the pouring joints, showed that the concrete had been placed too wet.

In making the repairs without removing tenants, the usual routine in replacing a single beam consisted in building a temporary wood partition, removing the permanent partition or wall over the beam, shoring the slab, wrecking out beam, replacing concrete of enlarged section, and then refinishing partition, plastering, etc. In some instances it was considered advisable to remove the entire slab panels along with the beams. In some cases it was possible to cut pockets in columns to receive new beams, while in others it was necessary to build a shell column around the old one to reinforce it and to form a beam seat, as indicated on one of the drawings.

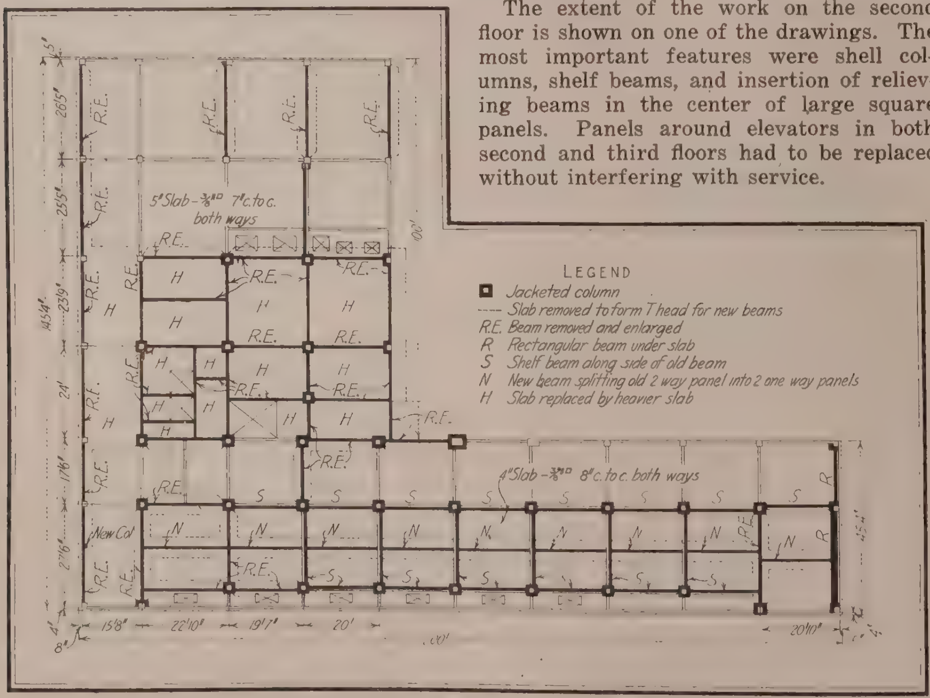

⅜"⌀ Hoops 9" c. to c.
New Beam
Old Beam Removed
Rods under New Beams 1"⌀ Others ⅞"⌀ or ¾"⌀
Old Beam
2-⅞"
10"
⅜"⌀ Stirrups 12" c. to c.
10"
5-⅞"
TYPICAL DETAIL OF SHELF BEAM
3"x 5½"
12" I.
⅞" Bolt
TEMPORARY REPAIR OF A DIAGONAL CRACK
Interior Column
Old Truss Steel
New Truss Steel
New Beam Wider and Deeper
Wall Col
Old Steel
New Steel
Pocket-Full Width of Beam
Shell Col.
Old Col.
New Steel Run Back into Old Concrete
Temporary Partition
Partition Removed
New Steel ½"⌀-10" c. to c.
New Slab
Old Beam
Old Slab
Old Steel
New Steel
New Beam
TYPICAL METHOD OF REPLACING BEAMS AND REINFORCING COLUMNS

DETAILS OF METHODS USED TO STRENGTHEN BEAMS AND COLUMNS

EXTENT OF REPAIR WORK

The bulk of the repair work consisted of replacing the front beams, reinforcing first-story columns, and strengthening the second floor. The front was handled in three sections of two panels each. In the three-story part all beams in two panels were removed at one time and replaced at one time, but in the four-story part a new column was introduced to divide a long span, and only one floor was taken every other day.

The extent of the work on the second floor is shown on one of the drawings. The most important features were shell columns, shelf beams, and insertion of relieving beams in the center of large square panels. Panels around elevators in both second and third floors had to be replaced without interfering with service.


LEGEND
■ Jacketed column
---- Slab removed to form T head for new beams
R.E. Beam removed and enlarged
R Rectangular beam under slab
S Shelf beam along side of old beam
N New beam splitting old 2 way panel into 2 one way panels
H Slab replaced by heavier slab
5" Slab-⅜"⌀ 7" c. to c. both ways
4" Slab-⅜"⌀ 8" c. to c. both ways
R.E.
H
S
N
R
New Col
15'8"
22'10"
19'7"
20'
20'10"

PLAN OF SECOND FLOOR INDICATES SCOPE AND NATURE OF REPAIRS

In only one place was it found impossible, on account of tenants, to replace old construction. Here channels reinforced with angle irons were placed top and bottom of the beams and bolted together where diagonal cracks had occurred, as indicated on the drawing herewith.

The cost of work of this character is naturally very high. Form labor ran about twice normal costs per square foot, concrete labor averaged about three times normal cost for new work, and finishing, while not so high in proportion, naturally ran higher than new work. A large additional expense was incurred in moving tenants where necessary and in making good the damages to their furniture and fixtures.

All badly cracked beams and several others only slightly cracked have been replaced, and the building can be considered reasonably safe. The building department, however, has the entire building under close observation for future developments. The design for repairs was made by W. T. Buck, architectural engineer, of Fort Worth and Houston, Tex., and the work was done by day labor under the direction of Mr. Buck. The original design and construction were by H. L. Stevens & Company of Chicago.

Stone Sidewalks Standardized

Until last year the city of Newton, Mass., allowed abutting property owners who desired artificial stone sidewalks and driveways to have the work done by any contractor they might select, at their own expense in the first instance. On completion of the work the city allowed the property owner the same amount that the city would have to pay if coal-tar concrete sidewalks were laid, instead of artificial stone. A different policy was adopted recently, according to the annual report for 1915 of Edwin H. Rogers, city engineer. Specifications for the construction of artificial stone sidewalks, driveways and curbing were prepared by the city's engineering department, proposals were advertised for and a contract for doing such work as might be ordered by the city was entered into with a local firm. Arrangements were made whereby the city paid substantially one-half the cost of this sidewalk construction.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Joints in Concrete Roads Laid Late in the Season

SIR: Referring to the article in the Engineering Record of Oct. 14, page 465, regarding widening of joints in concrete roads laid late in the season: To my mind concrete pavement laid in the fall is liable to all sorts of trouble on account of possible freezing of the surface and also expansion of the slabs the following summer, due to insufficient width of expansion joints. The proper remedy for these conditions is to get the concrete work done in the summer months, or at least completed early enough in the fall so that there will not be danger of low temperature.

CHARLES J. BENNETT,
State Highway Commissioner.
Hartford, Conn.

Hydrated Lime and Faulty Brick Piers

SIR: The writer has read with a great deal of interest Sanford E. Thompson's report on the causes of the failure of a school building at Roxbury, Mass., in your issue of Sept. 2, page 294.

This article brings home the unfortunate fact that manufacturers of certain standard materials of construction, such as cement, lime and gypsum, are compelled to depend upon factors of construction beyond their control, which in the past have often been the cause of failures. As an example, the reading of Mr. Thompson's report may possibly influence some to consider the use of lime as being partly responsible for the failure; but close analysis of the complete report shows clearly the abuses to which building materials, including lime, are often subjected.

The time of laying the brick masonry was during freezing weather; and Mr. Thompson's report indicates that the operation of slaking the lime was hurriedly done and that the lime was used before it was completely slaked, as unslaked lime was found in the mortar after the failure. Of course, the heat that is generated during the process of slaking lime may have been expected to ake the place of heating the materials; but this is poor practice. During the mixing of the mortar, apparently no attention was paid to the correct proportioning, as is evidenced by the great variation in the quantity of lime in different batches—fifteen shovelfuls of lime in one case and four in another.

With reference to the use of lime in cement mortar for brick masonry, results of carefully conducted tests completed during the last year reveal facts connected with the use of hydrated lime which are worthy of more than passing interest at this time. The developments referred to are those brought out in the investigation conducted in 1915 by Prof. James S. Macgregor at Columbia University, New York City. In this investigation hydrated lime was used throughout. In the use of this material absolutely accurate measurements may be made, of course, either by weight or by volume, and thus eliminate such wide variations as occurred in the building which failed.

On page 165 of the Engineering Record of Aug. 5 a summary of the results of Professor Macgregor's tests shows the increase in compressive strength at 7 days, 28 days and 3 months periods brought about by the use of varying replacements of Portland cement by hydrated lime. A mortar containing 50 per cent hydrated lime, 50 per cent Portland cement and three parts of sand shows a higher compressive strength at all of the ages mentioned, and at 90 days it is shown that a mortar of these proportions gives a compressive strength almost 1000 lb. per square inch in excess of that developed by a straight 1:3 cement mortar.

Judging from the results of this investigation, which showed that a volumetric replacement of Portland cement by hydrated lime up to 50 per cent was entirely on the safe side, there seems to be no question that a satisfactory and safe mortar would have resulted had a normal amount of judgment been used in mixing the materials and heating them to prevent freezing.

B. NAGY,
Chief Engineer, Hydrated Lime Bureau, National Lime Manufacturers' Association.
Pittsburgh.

Abnormally Slow Setting of Small Areas of Concrete

SIR: About a year ago I was called upon to examine some 72-in. concrete sewer pipe being cast and steam-cured for the city of Salt Lake, Utah, by the Lock Joint Pipe Company. The pipe were giving trouble at irregular intervals by sticking to the forms, leaving pitted spots, which had to be patched by hand. The concrete was poured into greased iron forms and steamed for two or three hours as soon as poured, then the forms were removed and steaming continued for a total of seven hours. The mixing, placing, and all operations seemed to be properly done, and the irregularity with which the sticking occurred seemed unaccountable.

In the pitted spots the concrete remained soft and crumbling for some time. While examining one of these I pulled out several fragments which crumbled easily between the fingers, and dropped them in my raincoat pocket. Several months later, on using the coat, I was surprised to find the pieces perfectly hard and sound.

Experiments made following the inspection showed the cement to be normal, and the sand was suspected, but no definite conclusion reached. Having seen cases of abnormally slow setting in large pieces, it occurred to me that this might take place in small areas which would ordinarily pass unnoticed. Accordingly, I have made experiments, the results of which offer a possible explanation.

Without going into the details of these operations, I would say that I have been able to reproduce the pitting effects by means of retarding the set locally, and I find that in these spots the cohesion may be about the same as, or less than, atmospheric pressure when the surrounding concrete has become set, which would explain the sticking to the forms. Although unable to work with the original material, I am convinced that certain substances which might easily be present in any sand or gravel near Salt Lake City will dissolve sufficiently by the heat of steaming to diffuse through a small area and exert a strong retarding effect before the rest of the concrete, not affected, has secured its set.

While this incident may be quite isolated, and my experiments of little interest to cement users, yet these conditions may be of more common occurrence than would be supposed, and I would like to ask through your columns if other cases of local abnormal retardation of set have been observed and studied.

E. G. PIERCE,
Consulting Chemist.
Youngstown, Ohio.

Estimated and Actual Cost of Baguio Railway

SIR: The article in your issue of Sept. 16, page 351, describing some of the features of the construction of the Baguio Railway, is of interest, both for what it tells of the conditions in the Philippines, as well as those under which this line was built, and also for the marked discrepancy between the estimated and actual costs of construction as quoted therein.

The estimate given in Table 1, said to have been made from a projected location, amounts to some $1,750,000, whereas it was stated that the actual cost was nearly $5,000,000. Practically no adequate explanation is made regarding this discrepancy, and final comment or criticism must be deferred pending further information, which it is hoped may be forthcoming.

It is true, the preliminary estimate did not include track, buildings, telegraph, water-supply or general expenses, engineering, etc., but it would hardly seem that on a line 25 miles long, even with the rack, these could have amounted to more than $1,000,000, possibly not half that, which still leaves a considerable discrepancy to be accounted for.

The article mentions some items of difference, namely, that concrete cost $15 per cubic meter (1.3 cu. yd.) instead of $5 as originally estimated, that the quantity of steel was increased to nearly double, that clearing was somewhat more costly, that the earthwork, while exceeding the estimated quantities, was carried out for approximately the estimated costs or even less, and that the length of the tunnels was nearly doubled.

There is some indication in the article that the preliminary estimate quoted might have been revised later, but for the benefit of engineers and others interested in the broader questions of railway economics, and especially at this time when American engineers may have a more extended interest in railroad construction in foreign countries, further light on this phase of the situation will be of interest.

As the matter stands now, the question naturally arises as to whether the decision to adopt the rack line on 12 per cent gradients was affected by these estimates, whether more nearly correct estimates were made before a decision was arrived at, or whether if an estimate had been made more nearly in accord with the facts as developed by actual construction a different decision would have been reached.

It will be of not a little interest to know later on how the cost of operating the rack line compares with costs on adhesion lines on the same railroad, both the actual operating cost per ton-mile reduced to a unit providing for the actual "work done" in overcoming elevation as well as distance, and also the maintenance cost per mile of line.

F. Lavis,
Consulting Engineer.

New York City.

[A copy of the foregoing letter was sent to Mr. Butts, author of the article in question, and his comments on it follow.—Editor.]

Sir: Your letter containing comment by Mr. Lavis on my article received.

Mr. Lavis is under the impression that I stated that the cost of the Baguio Extension was $5,000,000. In the middle of page 352 the following appears: "And probably one of the most expensive for its length, as the cost will probably reach $5,000,000." The same paragraph says: "The European war necessitated the cutting down of the work, but its completion, which will require 2 years, is assured."

The estimate shown in tabulated form was made in 1911. In 1912 construction work was begun, and because the government officials wanted the road finished at the earliest possible moment, a factor entirely unforeseen, work was pushed from both ends at the same time, necessitating hauling by automobile trucks and by carts a distance of about 30 miles. As the government owned and operated the automobile line, the expense was even more than it would have been under railroad management. The haul was also increased when the rainy season required the removal of the railroad track at Camp 1, making the haul about 50 miles.

Next in line to increase the cost of the line above any foreseen difficulties was the constant friction with the government-hired and incompetent foreman, who reported to the governor of the mountain province and not to the engineer in charge. The money wasted because the engineer in charge could not handle the foreman and the labor as he wanted to, but instead had to submit to unheard-of red tape, was enormous. Then all reports and every move the railroad company made had to be O. K.'ed by the government before anything could be done. Duplicates of all reports had to be handed the government, and all surveys had to meet with the approval of the government "expert."

Next appeared an engineer from Switzerland, who was to act as consulting engineer. He could speak neither English nor Spanish; and although he was a fine man personally and perhaps as good an engineer as could be found, he took issue with American practice, with the use of reinforced concrete and with the use of degrees of curvature instead of radii, and generally unsettled everything because he did not have the proper authority to carry out his ideas, but could hold up and delay all work.

This Swiss engineer next brought a dozen more Swiss, Italians, Montenegrins and Germans, with whom he had formerly been associated, to the islands, all of them at round salaries. They were given charge of the tunnel work and were supposed to act under the instructions of the resident engineer; but they devoted themselves largely to causing all the trouble possible. They could not talk to the workmen, and only through an interpreter could they communicate with the resident engineer. Friction of all kinds resulted, and finally nearly all of them went back to Europe after having accomplished nothing at all compared with the expense they had been to the company.

Finally, the Swiss consulting engineer succeeded in effecting changes in the line and abandoned parts already finished. The tunnel distance was nearly doubled and concrete piers were discarded for piers built of cut stone where concrete materials were easy to get and cut stone was exceedingly expensive. The tunnel sections were unnecessarily enlarged, and rammed concrete placed practically dry was the final step.

Of course, the facts that the cost of clearing was underestimated, the drainage areas were increased and numerous slides were met with did increase the cost of the work considerably, but I think that every engineer who came into intimate contact with the work will account for the expenditure of more than was estimated by reviewing the friction between the government and the railroad, the red tape necessitated by the fact that the government was advancing the money and guaranteeing a 4-per cent interest on the same and because the consulting engineer was not in accord with American practice.

W. M. Butts,
Assistant Division Engineer, Nashville, Chattanooga & St. Louis Railway.
Tullahoma, Tenn.

Time to Abolish "Yardage"

Sir: Yardage expresses a pet inconvenience which engineers fondly cling to from habit only. They assume that quantities of area and volume of certain classes of construction must be referred to in yards, as that is the established custom. Many young engineers realize that this is a mistaken idea and should be abandoned, but they are seldom in a sufficiently independent position to act contrary to the established "trade custom." The use of yards to express quantities of masonry and concrete work is particularly inconvenient. For earth and roadwork it is also very inconvenient and is an item of considerable cost.

The most common reason given is that large quantities require large units. The ridiculous feature of this explanation may be noted by referring to data usually published of dams. The quantities of earth and masonry in the dam are ordinarily given in cubic yards and the amount of water impounded is given in gallons, although this is a reversal of the idea of using large units for the larger quantities. Volumes of concrete when reduced to cubic yards are usually given to tenths, often to hundredths and sometimes to thousandths of a cubic yard, thus losing any possible advantage which might be claimed for the yard as a large unit which requires the use of less figures to express.

The square yard as a unit for pavements is convenient in size for stating construction costs, but rather a small unit for maintenance costs and unreasonably small for cleaning costs and data. Many engineers use the square yard as a pavement unit in order to show a comparison of costs with other localities, but it is now realized that a uniform unit of measurement is of slight value in comparisons unless similar items of cost are covered in all cases, and this is not the usual condition.

On practically all construction work the foot is used as the unit in which dimensions are measured. The transformation of volume to weight is usually based on tables giving weights per cubic foot of materials. Practically all areas and volumes are first estimated in feet and then divided by 9 or 27 to reduce the results to square or cubic yards. This work of translating quantities from feet to yards is all waste work and is also a prolific source of error. Every engineer is supposed to be an efficiency engineer to the extent of dispensing with all useless labor.

The expense of this constant reduction of quantities from feet to yards can be conveniently shown by using highway construction as an example and estimating the cost of reducing the quantities in cubic feet to cubic yards.

Road Surveys—Assume eighty cross-sections per mile. The quantities would be figured and checked at least three times, a first and a final estimate by the engineer and one by the contractor. Each reduction to yards averaging one minute, the cost per mile may be taken as follows:

80 × 6 = 480 min. = 8 hr. at 70c. = $5.60

Bridges and Culverts — Assume three classes of concrete in each structure, each class being reduced to cubic yards. A first and final estimate made by the engineer and eight bidders figuring the work, each operation being checked, the cost per structure may be taken as follows:

3 × 10 × 2 = 60 min. = 1 hr. at 70 cents.....	$0.70
Add for excavation, materials, etc............	.30
Total	$1.00

This shows a useless expense of more than $5 per mile of road surveys and $1 each for structures. Bridges and culverts will average at least one per mile of road, making the total more than $6 per mile of road.

In the United States about 16,000 miles of improved roads are now being constructed per year and about 16,000 × $6 = $96,000 is being spent annually for worse than useless work in reducing quantities to yards.

The Federal Aid Road Act will assist in the construction of about 25,000 miles of road, and $6 per mile, or a total of $150,000, may be estimated as the cost of reducing all quantities to yards on this work. If the maximum possibility of this item is desired, the cost per mile may be applied to the 2,175,000 miles of unimproved rural highways of the United States.

By the use of tables, slide rules, etc., reductions may be done more quickly than estimated above, but the reductions of surface area to square yards, not included in the estimate, will probably overbalance any saving of time made by mechanical means.

The use of yards (and barrels) on concrete work has been a very decided factor in the confusion of ideas attendant on the use of concrete. The Joint Committee on Concrete and Reinforced Concrete has presented a report in which, under "Preparing and Placing Mortar and Concrete," it specifies: "The unit of measure should be the cubic foot. A bag of cement containing 94 lb. net should be considered the equivalent of 1 cu. ft."

The capacity of nearly every concrete-mixing machine is now rated by the manufacturer in cubic feet. The Cement Users' Association some years since adopted rules for the measurement of concrete work in which it was specified that the unit of measure for concrete should be the cubic foot. Cement is usually handled in sacks, and under nearly all specifications one sack of cement is considered to be 1 cu. ft. This naturally requires the other materials to be measured in cubic feet in order to use proportions as specified. It is hard to understand why material which is fed into a mixer and mixed in cubic feet must be expressed in cubic yards when it leaves the mixer and is placed in the work.

If a larger unit than feet is desired, some unit based on the decimal system of numbers should be employed. Larger units consisting of groups of 10, 100 or 1000 of the smaller units are found to be very convenient in many classes of measurements, and there is no reason why this system cannot be applied to engineering construction.

O. W. CHILDS,
Office of Public Roads and Rural Engineering.
Washington, D. C.

Who Shall Select the Types of City Pavements?

SIR: The stand taken by your journal in the matter of who should select the type of pavement to be used on a particular street (see Engineering Record, July 8, page 35, and Oct. 14, page 458) is undoubtedly the correct one. The selection of pavement should be left solely to the responsible official in charge of the paving department of the city, by whatever title known. If he is not competent to make such selection he cannot be made competent by petitions. Abutters are not usually qualified technically to determine the best kind of pavement to be used. In any case, the personal interest of the petitioner takes precedence of the interests of the traveling public, especially where the street is extensively used.

The foregoing statements hold good even though petitions are actually what they purport to be—the expression of an honest belief that a particular type of pavement is the one best adapted to the locality. If signatures are made on account of friendship with a contractor or a director of a paving corporation, or secured by paid canvassers, the petitions are obviously of no value. Petitions for paving streets are particularly easy to secure, especially in cities like Boston, where the city bears the entire expense of repaving.

The officials in Boston have been, however, remarkably free from annoyance by paving petitions, the practice being practically confined to advancing the interests of one firm of contractors. The methods that have been used are well shown in a report of the Boston Finance Commission.

On the other hand, I doubt that in the majority of cases petitions alone have any effect in influencing the decisions of paving officials. So far as my observation goes, petitions for paving, as well as for other municipal actions, are particularly used as "accessories after the fact" to furnish an excuse for actions previously determined upon, regarding which the official expects criticism.

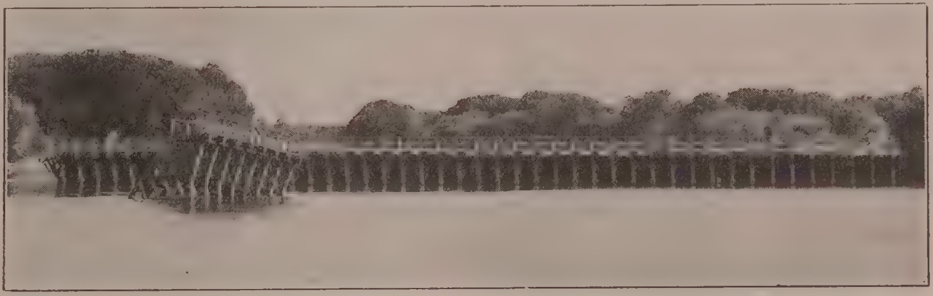
If the responsible official is honest and competent, I fail to see why petitions for paving should cause him any embarrassment.

GUY C. EMERSON,
Boston. Civil Engineer.

Wooden Dam Fails When Foundation Scours

SIR: The recent failure of a timber diversion weir, 380 ft. long and 16 ft. high, on the San Joaquin River, near Mendota, Cal., is of some engineering interest, particularly as the weir is of that class in which "piping action" is a vital feature. In other words, it is a weir built on a permeable foundation. In this connection I call your attention to the paper by W. C. Hammat in the *Transactions* of the American Society of Civil Engineers, December, 1913, entitled "A Western Type of Movable Weir Dams." The Mendota weir is mentioned in this paper. The illustrations in the paper (Mr. Hammat's) give an idea of the construction of the weir, although, apparently, none of his sections are for the weir in question.

I have not personally visited the failure. I have, however, investigated the circumstances sufficiently to know that the descriptions given in the newspapers are approximately correct.



WOODEN DAM FAILS WHEN FOUNDATIONS ARE UNDERMINED

Assuming that the dimensions as given are accurate—a 50-ft. watertight floor, two lines of 14-ft. sheet piling, and a difference of 10 ft. in the head at the time of failure between the overflow level and the level of the tail water—it is interesting to apply the principles for design of this type of weir, as so admirably treated by W. G. Bligh in his "Practical Design of Irrigation Works." The length of enforced percolation in this case is equal to the length of floor plus four times the length of the sheet piling, or 50 ft. plus 56 ft., or 106 ft. With a head of 10 ft. the percolation or "piping" factor is 10.6. Mr. Bligh's recommended value for a soil of this nature is 15. It is very possible, also, that the floor was not watertight. In fact, in reading Mr. Hammat's paper the inference was gained that in many of these timber weirs, weep holes were purposely left in the wooden floor.

The publication of the description of this weir failure may bring more definite data from engineers who may be familiar with the design of the structure.

HENRY D. DEWELL,
San Francisco. Civil Engineer.

[An account of the failure, prepared by this journal's Pacific Coast representative, is appended.—EDITOR.]

Just below the junction of the San Joaquin and Kings rivers, in Southern California, there was constructed, in 1908, a wooden dam 350 ft. long and 16 ft. high from floor to deck. Recently a break occurred, apparently caused by the undermining of foundations, in which a 65-ft. length was washed out, releasing the waters of the reservoir and cutting off the supply of a large area of irrigated land in the upper San Joaquin Valley.

The dam foundation consists of three rows of sheet piling transverse to the stream, 25 ft. apart, and driven 20 ft. in the sandy bottom. These were tied together with 10 x 12-in. timbers, which also served as sills for the floor, which was 50 ft. wide, made of 2 x 12-in. planking. At the dam site the river bed is entirely drifted sand. F. W. Bomar, the company's resident manager, examined the structure immediately after the failure. He thought that the first cause was a slight break in the downstream row of sheet piling, which allowed the sand to escape from under the floor. The failure occurred, he believed, after the foundation had been washed out to such an extent that it would not bear the weight of the water on the upstream face of the dam, which is inclined at an angle of 30 deg. At the time of the failure the water level in the reservoir was 10 ft. higher than the downstream level.

The first evidence of the failure was a 3-ft. settlement of the section washed out, after which the pressure of the escaping water carried away the wrecked portion. If the defect had been in the upper row of piling the structure would have "buckled up," Mr. Bomar pointed out. The break occurred 50 ft. from the east end and the washed-out section separated into two parts, one of which lodged near the structure, while the other continued about 100 ft. downstream.

Temporary relief will be provided by a timber-and-brush dam being constructed upstream. It is expected that this will serve the canals during the brief remaining period of the present season. Meantime plans for reconstruction at the old site will be prepared.

Although the old wooden dam is about eighteen years old, its timbers are said to be sound and the structural connections intact. Until the site is unwatered decision will not be made as to whether it would be better to repair the wooden structure, which originally cost about $30,000, or to build a concrete dam at an expenditure of about $75,000.

The structure is owned by the San Joaquin and Kings River Canal & Irrigation Company.

Power Station First of Its Kind to Be Built in Iceland

A hydroelectric plant has been proposed for the city of Reykjavik, Iceland, and a Norwegian firm of engineers engaged to prepare plans for the project. This is the first plant of its kind to be built in Iceland. As no runoff data are available the stream must be gaged and the drainage basin surveyed. A high-tension transmission system is also to be included in the design.

HINTS FOR THE CONTRACTOR

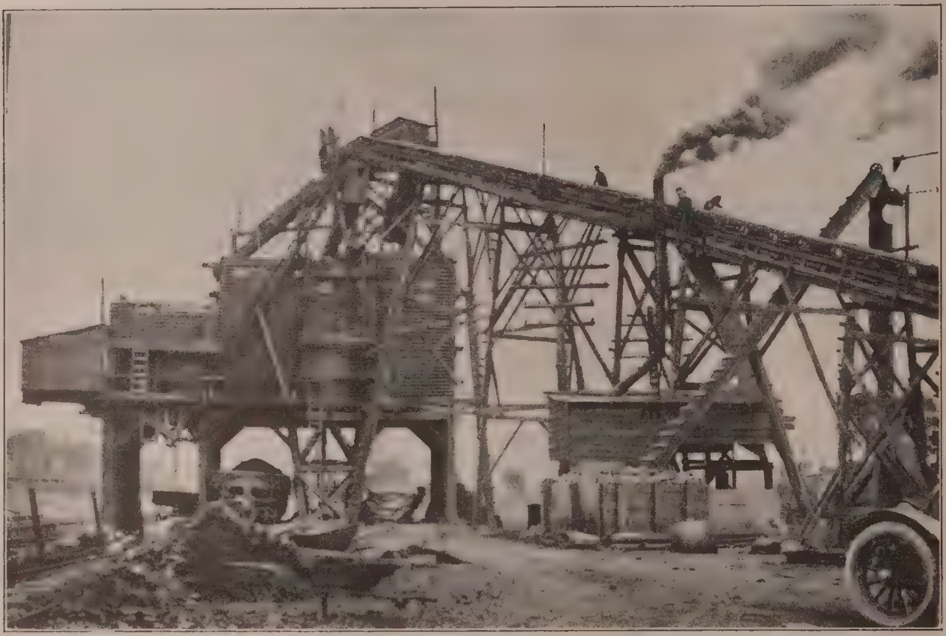
Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Readily Built Bin Has High Salvage Value

THE type of bin shown in the photograph can be very quickly built, requires no framing and no bolts except a few tie rods, and can be readily dismantled so as to leave the lumber in practically as good shape as before use. This bin is fairly common in Canada, but seems to be little known to American contractors. The one here shown is part of the gravel-screening plant of O'Brien & Doheny and Quinlan & Robertson in use on Section 3 of the Welland Ship Canal, described in last week's issue of the Engineering Record, page 490. The posts and floor are made of 12 x 12-in. timbers, while the bin walls are made of 2 x 8-in. plank, laid flat in a manner resembling the construction of a log crib, with a few light nails through each plank at each intersection. Of course, sand or gravel stored in such a bin and drawn out by bottom gates must slide on itself, and the design of a bin of this character contemplates having the corners permanently filled with material. While this means supporting extra weight and a slightly steeper angle of slope on which the material will slide, somewhat reducing the capacity over a hoppered bin of the same height, the plank cribwork can be put up so much more rapidly and cheaply than the framed construction that these disadvantages are outweighed. In addition practically all the lumber used in such a structure is saved.



BIN USED ON WELLAND CANAL WORK EASILY BUILT WITHOUT SAWING LUMBER

Work on the Welland Ship Canal is under the direction of J. L. Weller, engineer in charge for the Department of Railways and Canals of the Canadian government.

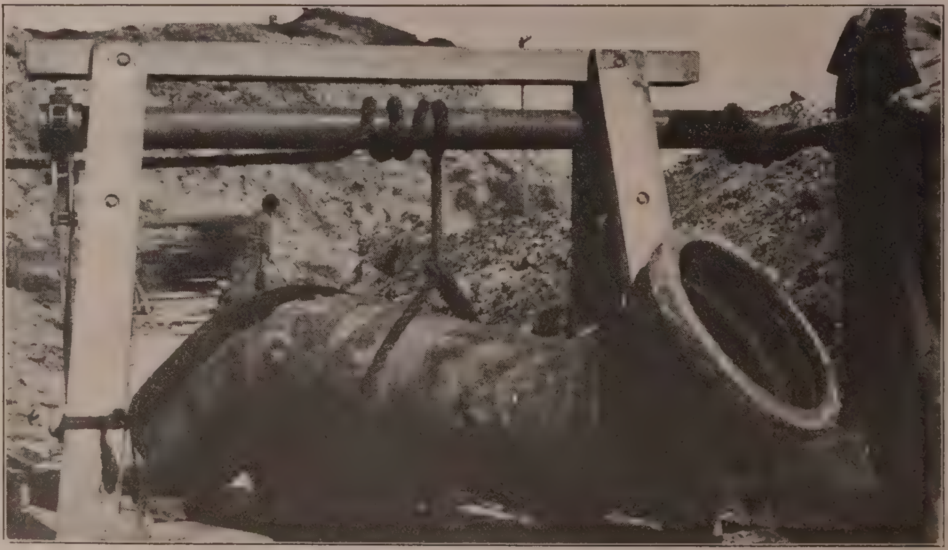
Windlass Replaces Tripod and Derrick for Pipe Laying

A PIPE-LAYING appliance which has taken the place of the three and four legged derrick for pipe up to 16 in. in diameter was described by G. E. Keppelmann, of the Pacific Gas & Electric Company, in a paper presented at the recent annual convention of the Pacific Coast Gas Association. The method should be equally effective for laying water mains.

A wooden trestle supports a windlass pipe turning on wooden bearings by means of a common pipe chain tongs and operated by one man at one end of the pipe, while at the other end a ratchet is screwed to the pipe and fastened to one leg of the trestle. The ratchet prevents any reverse motion in the pipe.

The fitting or pipe to be lowered is rolled or skidded in the usual manner over the trench, a rope is fastened to it and the free end is wrapped four times around the transverse pipe, acting as a windlass. One man handles the chain tongs and another takes in the slack rope, while the ratchet automatically takes care of any slip on the part of either man. When the skids are cleared they are removed, and the fitting is lowered in place by the one man easing up on the rope. This must be done carefully to avoid surges that might break the rope.

In the case of pipe of any diameter so far used (up to 16-in. cast iron) the rope is fastened a little to one side of the center toward the bell, and on being lowered the spigot end is depressed in order to clear any dirt that may have lodged in the pipe.

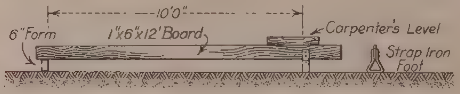


TWO MEN LOWER PIPE IN TRENCH FROM WINDLASS ARRANGEMENT ON SINGLE TRESTLE

Device Checks Subgrade on Concrete Road Construction

By RALPH P. BROWN
Urbana, Ill.

A DEVICE to permit inspection of the subgrade before the second line of forms was set was perfected last summer by P. M. Johnston & Company. It was used on a 10-ft. concrete road in Illinois. Inspection of the subgrade was necessary because it was possible to set only one line ahead of the mixer, as a side-loading machine was used the hopper of which interfered with setting the other line. A 1 x 6-in. piece of board 12 ft. long was fitted with a strap iron foot on one end, as shown in the sketch, and an ordinary carpenter's level attached. It was not practicable to use a bubble tube, because of rough handling. The device enabled the form setter or inspector to check the subgrade and adjust the line of forms for small variations of the grade.



DEVICE USED TO CHECK SUBGRADE

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Alfred Craven Retires as Subway's Chief Engineer

Becomes Consulting Engineer to New York Public Service Commission—D. L. Turner Appointed Acting Chief Engineer

Alfred Craven will retire Nov. 1 as chief engineer of the New York Public Service Commission, in charge of the city's subway construction, and will occupy the newly created position of consulting engineer to the commission. This action, according to a letter made public this week, comes at Mr. Craven's own request and was approved by the Public Service Commission at a meeting Oct. 17. The commission also has announced the promotion, on Nov. 1, of Daniel L. Turner, formerly deputy engineer of subway construction, to the position of acting chief engineer at a salary of $12,500. Mr. Craven, as consulting engineer, will receive a salary of $12,000. The commission has not, as yet, announced any appointment to the vacancy of chief engineer, but the compensation of this position has been reduced from $20,000 to $15,000 a year. Comment upon the change in personnel of the commission's engineering department will be found in the editorial columns of this issue.

Mr. Craven's Record

Alfred Craven, a son of the late Admiral Craven of the Navy, was born Sept. 16, 1846, at Bound Brook, N. J. He received his education at the U. S. Naval Academy at Annapolis, from which institution he was graduated in 1867. He then entered the naval service, where he remained four years, resigning to accept a position with the California Geological Survey. He stayed with that organization for two years. The next eleven years were spent in private practice as a civil and mining engineer in California and other Western states.

In 1884 he came to New York and accepted the appointment of division engineer with the Croton Aqueduct Commission. On completion of the aqueduct he was retained to supervise the construction of several large dams and reservoirs in the Croton Valley, after which he was put in charge of the construction of the Jerome Park reservoir. He remained with the aqueduct commission until 1900, when he resigned to become division engineer with the Rapid Transit Commission, in which capacity he supervised the construction of a section of the Manhattan subway. On the completion of the present subway Mr. Craven was appointed deputy chief engineer, under George S. Rice, who succeeded William Barclay Parsons as chief engineer. Oct. 1, 1910, on the retirement of the then chief engineer, Henry B. Seaman, Mr. Craven was assigned to duty as acting chief engineer at the salary of $10,000 a year. A year later he was appointed chief engineer at a salary of $15,000 a year, and in 1914, when the work of the dual system was in full swing, his salary was raised to $20,000 a year, the highest remuneration paid any public official in the State of New York.

Mr. Craven's Letter of Resignation

Mr. Craven's letter of resignation and a reply from Commissioner Straus follow:

THE HON. OSCAR S. STRAUS,
Chairman, Public Service Commission
for the First District.

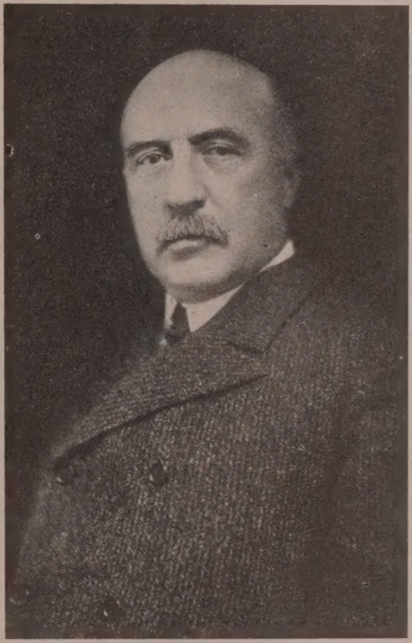
DEAR MR. CHAIRMAN:

I have for some time contemplated requesting the commission that I be retired from the position of chief engineer. You will recall my statement to this effect in talking with you today, as well as on a prior occasion several months ago.

The work of advancing the last of the principal construction contracts for the dual subway system is now about complete and the work of actual construction is already well advanced toward completion, while many miles of the system are now in actual and successful operation. I feel, therefore, the time has come when I can properly make this request for retirement, and I ask that you present this matter to the commission for its consideration.

As to your suggestion that I remain with the commission in the capacity of consulting engineer, I shall be pleased to consider such an offer or request should the commission desire to make it.

Chief Engineer of New York Subways Resigns—Becomes Consulting Engineer to the Public Service Commission



ALFRED CRAVEN

I remain, dear Mr. Chairman,
Yours very truly,
(Signed) ALFRED CRAVEN.

Chairman Straus' reply to Mr. Craven was:

ALFRED CRAVEN, ESQ.,
Chief Engineer, Public Service
Commission for the First District.

DEAR MR. CRAVEN:

I have the honor to acknowledge receipt of your letter of the 13th inst., wherein you inform me that for some time past you have contemplated requesting the commission that you be retired from the position of chief engineer.

The commission, acting in pursuance with your request, have accepted your resignation to take effect on November the first. The commission further resolved, in appreciating the valuable and important services you have rendered and for the purpose of retaining your experienced co-operation in a less exacting ca-

(*Continued on page* 544)

Green Concrete Blocks New York Subway Track

Failure of Sidewall Form Allows Concrete to Run Over Third Rail, Delaying Traffic an Hour—Work Is Well Advanced

The failure, Oct. 22, of a sidewall form being filled with concrete next to the northbound express track of the present subway between Fortieth and Forty-first Streets and Park Avenue in New York City, allowed several yards of wet concrete to run out over the third rail and track as a northbound express train was passing. Express traffic on that track was delayed for about an hour. The accident occurred just before 11 o'clock in the morning, at a time when the form was filled to a height of 6 or 7 ft. above the bottom. The motorman of the express train brought it to a stop, the passengers were transferred to a northbound local on the adjoining track and the express train was cut in two at the point of the break. The concrete was shoveled from the track and traffic resumed. The total delay was about an hour, during which time express trains were sent north over the local track.

The form which failed was a wood wall form secured with rods similar in design to the usual practice on subway work. After the form gave way, some part of it appeared to have been struck by the express train, but it is no longer possible to determine what part of the form broke first.

Progress of Subway Work

The section on which the accident occurred is one of the most interesting under construction on the new dual rapid transit system, and was described on page 255 of the Engineering Record for Aug. 28, 1915. The northbound and southbound tracks on the present subway are carried in independent tunnels separated by a big core of rock. The turnout section being constructed will connect these tracks with the new Lexington Avenue subway. As will be remembered from the article referred to, the new express tracks are carried under the present northbound tracks. They come up in the core of rock between the old tunnels, being broken into the old tunnels on each side by an unusual method of construction which replaces half of the old tunnel arch and takes the thrust from the other half across the new track to the rock wall. This portion of the construction is virtually completed, and the structure enclosing the new express track has been finished north to the point where they dip under the present northbound tracks.

It was about 75 ft. south of this point that the form which broke was being filled with concrete carried in over the top of the wooden lining which temporarily enclosed the northbound tracks of the old structure. It was necessary to replace the concrete arch over the old structure, as new work left it without support on either side. The street over this section had accordingly been decked, a lining of wood lagging secured to angle irons had been placed inside the old tube and the old concrete cut away. When the concrete for the depressed structure enclosing the new express tracks had been finished along this stretch, work was begun on the new structure to enclose the present tracks, the concrete being carried in cars from the plant at Forty-second Street and Park Avenue. In prosecuting this work since the accident, the additional precaution is being taken of having men stationed below the forms on the present running tracks to keep a constant watch for any occurrence that might cause a repetition of the accident.

Except for this delay to traffic, the extraordinary work of cutting into the old tubes at this point has been virtually completed without interfering in any way with the full operation of the existing subway. The new southbound local track has been constructed beneath the four tracks in use, and completed to the south side of Thirty-eighth Street, where the work of cutting it into the present southbound local track is practically completed. The work of cutting the two new express tracks into the two old ones is entirely finished, and the only difficult job remaining is the building of the new express structure beneath the present northbound tube, where work is just being started. The portion of the diagonal station in the Grand Union lot at the corner of Forty-second Street and Park Avenue is also nearly finished.

On the other portion of this contract, which included the work of extending the Steinway tunnels to Park Avenue underneath the new and existing subways, work has progressed so far that the new structure has been in use for some time. Work on these sections is being carried out by the Rapid Transit Construction Company, of which George H. Pegram is chief engineer and Robert A. Shailer, tunnel engineer. The work is under the direction of the Public Service Commission, of which Alfred Craven is chief engineer, Robert Ridgway, engineer of subway construction, and John F. Meyers, division engineer in charge of the district including the section.

Will Draft Bill Creating Minnesota Conservation Department

A bill calling for the creation of a state conservation department to have charge of all reclamation, drainage and relief work in Minnesota will be drafted and presented to the next legislature. The action is the result of a recent visit to Minnesota by M. G. Barnes, consulting engineer, of Albany, N. Y. Mr. Barnes is quoted as saying that "much of the drainage work being done in Minnesota is causing more harm than good. It may improve lands it is intended to improve, but it damages a greater area. The present condition is largely due to the fact that the creation and planning of drainage systems are the duties of county commissioners instead of being vested in one central power with an organization to study and plan for the whole state as a unit."

National Conference on Universities and Public Service Nov. 15 and 16

The third national conference on universities and public service will be held Nov. 15 and 16 at the University of Pennsylvania, Philadelphia. The convention is under the auspices of the Society for the Promotion of Training for Public Service.

Good-Roads Show to Be Held in Boston February 5 to 9

The eighth national exhibit of road machinery and materials will be held Feb. 5 to 9, in the Mechanics Building, Boston. The show will be in connection with the fourteenth annual convention of the American Road Builders Association.

114-Mile Windstorm Hits the South

The southern states were swept by a severe windstorm Oct. 18, during which the wind is said to have reached a velocity of 114 miles per hour. One life was lost. The damage to property was small compared to that caused by the hurricane of last spring. The barometer at Pensacola, Fla., registered 29.05.

"The Engineer," by Dr. Frank Crane

In printing the article entitled "The Engineer," by Dr. Frank Crane, in the Oct. 21 issue, notice of the copyright was omitted. "The Engineer" is copyrighted by Frank Crane and was reprinted in the Engineering Record through courtesy of the Associated Newspapers, New York City.

Alfred Craven Retires as Subway's Chief Engineer

(*Continued from page* 543)

pacity, to tender you the position of consulting engineer at a salary of twelve thousand dollars per annum. I hope it will be agreeable to you to accept this new appointment, which the commission takes great pleasure in tendering to you.

With the assurance of my highest esteem,
Very truly yours,
(Signed) OSCAR S. STRAUS,
Chairman.

Mr. Turner Named Acting Chief

Daniel L. Turner, who becomes acting chief engineer of the Public Service Commission Nov. 1, was graduated from Rensselaer Polytechnic Institute, Troy, N. Y., in 1891. During the next year he was instructor in mathematics at the institute, and then spent a year in general railroad practice. From 1893 to 1900 Mr. Turner was instructor in surveying and hydraulics at the Lawrence Scientific School, Harvard University, and at that institution organized and conducted the summer school in surveying. While at Cambridge he also supervised construction of the Harvard Stadium. In January, 1900, Mr. Turner became assistant engineer on the New York Rapid Transit Commission, and later was made general inspector of subway stations, in which capacity he served until 1907.

With the creation of the new Public Service Commission in 1907 Mr. Turner became chief of the bureau of transit inspection and in this capacity formulated the procedure by which the commission exercises control over service on the city's various rapid transit lines. His next work was as division engineer on the subway, under Mr. Craven, and from this post he was promoted to deputy engineer of subway construction, his immediate superior being Robert Ridgway, engineer of subway construction. In this position his duties were largely executive and concerned the headquarters department. As acting chief engineer Mr. Turner will be the ranking man of the Public Service Commission's engineering organization, pending the appointment of a chief engineer.

Illinois Engineer Company Ordered Home from Texas

Company A, Illinois Engineer Corps, was ordered home Oct. 17, but at the time of writing it was not known whether to Chicago, Springfield or Fort Sheridan. Lieut. H. S. Baker, assistant city engineer, preceded his company by a week. The Chicago Association of Commerce has organized a service to put the returning national guardsmen in touch with positions as quickly as possible. There have been about 150 applicants, and places have been found for two-thirds of them. A total of 200 positions open were listed. The engineers can also avail themselves of this service.

Seepage Through Earth Dike Causes 25-Foot Gap

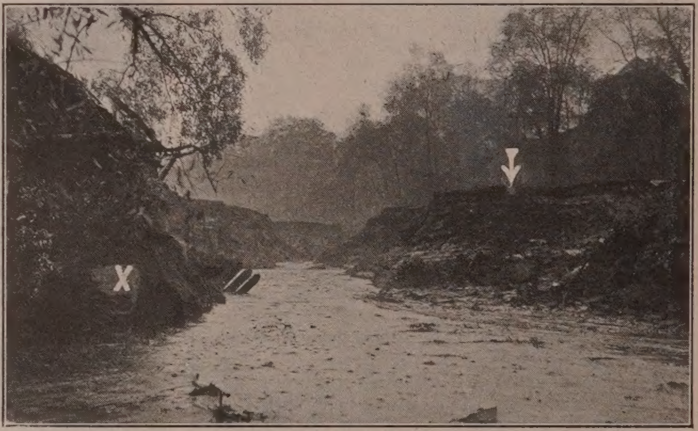
Washing Away of Embankment at Schenectady, N. Y., Results in $40,000 Damage—No Lives Lost

Part of a dam owned by the Schenectady (N. Y.) Milling Company failed at midnight Oct. 19. The uncontrolled water flooded several business blocks, twisted a wooden mill building from its foundation, and caused damage estimated at $40,000. No lives were lost.

The dam was faced with wooden sheet piling and backed with an 18-in. masonry wall. The 20-ft. intermediate space was filled with earth. An earth dike extended from the south end of the dam to the south bank of the pond. Through this dike seepage started and quickly caused a 25-ft. section to be carried away. The break came during a heavy rain at midnight.

Tons of Silt Carried Away

The dam and dike held back a pond from which water was carried in a 20-in. steel pipe to a point where about 40 hp. was developed under a 20-ft. head. The natural bed of the stream was 20 ft. below the top of the dam, but accumulated silt deposits had reduced the depth of water to only 6 ft. The scouring action of the water cut a channel in the soft bed of the pond as shown in the picture and removed tons of dirt and silt. The arrow on the right indicates the elevation of the bed of the pond. The cross is drawn at the back of the dam. Some of the wood facing is seen where it has fallen into the water. The high place at the left of the picture is the top of the dam.



LOOKING THROUGH THE GAP IN THE EARTH DIKE OF THE DAM AT SCHENECTADY, N. Y., THROUGH WHICH TONS OF SILT WERE CARRIED AWAY BY THE RELEASED WATER

This information was supplied by Warren C. Taylor, assistant professor of civil engineering, Union College.

Pennsylvania Highway Engineers Meet for Annual Conference

Engineers and superintendents of the Pennsylvania highway department met at Harrisburg Oct. 18 in annual conference on engineering and maintenance problems. Frank B. Black, commissioner of highways, and W. D. Uhler, chief engineer, addressed the gathering. The engineers spent the following two days inspecting roads in southern Pennsylvania and Maryland.

Advisory Board of Railroad Presidents for University of Illinois

The college of engineering of the University of Illinois is to have the benefit this year of an advisory board for the railway industries of Illinois, which, upon the recommendation of the dean and the approval of the president of the university, has recently been appointed by the trustees. The presidents of five of the larger railroads centering in Chicago, and having their administrative offices in that city, have consented to serve as the members of this advisory board.

Elephant Butte Dam Was Dedicated October 19

Settlers' Problems Discussed at Twenty-third Irrigation Congress—Rain Caused Postponement of Dam Dedication

The twenty-third National Irrigation Congress convened at El Paso, Tex., Oct. 16, 1916, with President R. F. Burgess, of that city, presiding. The opening session was to have marked the dedication of Elephant Butte dam Oct. 14 as announced in that issue of the Engineering Record. Heavy rains caused a postponement of the dedication exercises to Oct. 19.

The first address after the opening exercises was by A. A. Jones, first assistant secretary of the interior. He brought out the fact that the chief problem now before the irrigation projects of the west is the settlement of the lands, aiding settlers to get a start, and the securing of better marketing facilities. He also stated that the national irrigation fund is now nearly exhausted and that the Irrigation Congress should suggest means whereby this fund could be increased.

Means for Securing Government Aid

Among the more important discussions was that of means for securing additional government aid. The Jones bill, which provides for the guaranteeing of interest on irrigation bonds by the federal government, was discussed as one solution; methods and means for stabilizing and unifying irrigation district laws and increasing the value of the lands in the investment market through additional laws and better supervision was another. The construction of storage reservoirs in the national forests from the proceeds of the sale of ripe timber was suggested as a third remedy. On the other hand the question of relief from payment of at least a part of the obligations on government reclamation projects, on account of alleged engineering mistakes and of works constructed for general flood protection, was brought out.

Several papers were read on the operations of existing irrigation district laws and cooperation with the federal government in carrying out provisions of and securing the benefits from these laws. "How to Secure Settlers" was the subject of much discussion. It was said that it is not enough to sell the land to people for investment purposes. Unless settlers actually come upon the land, farm it properly and prosper, the project is a failure. Attempts to handle too large an acreage, insufficient capital, and ignorance of irrigation farming were given as the three potent causes of the failure of individuals.

Rural Credits Discussed

Among the more active causes of seepage are an impervious subsoil, poor irrigation methods, excessive irrigation and leaky ditches, according to the discussion. The question of proper methods of drainage was said to be much more difficult to answer on irrigated lands than on swamp lands owing to the many unknown factors. The engineer must therefore rely chiefly upon judgment and experience in selecting an adequate system.

Rural credits was the subject of several papers. The conclusion drawn was that some form of federal or state aid be adopted whereby tenants or other persons might, without capital, become land owners, and thereby increase the number of prospective settlers.

Papers on markets and marketing occupied one period of the congress. Co-operation between the farmers and the formation of produce associations was thought to be the best method of handling this question. That some means must be devised for reaching the consumer without the excessive toll now exacted by middlemen seemed to be the sense of the convention.

At the concluding session George Albert Smith, of Salt Lake City, was elected president, and Arthur Hooker, of Spokane, reelected secretary. The next convention city has not yet been chosen.

Elephant Butte dam was formally dedicated Oct. 19, under the auspices of the International Irrigation Congress. The principal address was made by A. A. Jones, first assistant secretary of the interior, who was present as the personal representative of President Wilson. Mr. Jones reviewed the events which led up to the construction of the dam and pictured the development which is to come to the valley below through its operation. Congressman W. R. Smith made a short address bearing chiefly on the co-operation of the different interests that have worked together in the development of the project. A. P. Davis, director and chief engineer of the U. S. Reclamation Service, discussed the engineering phases of the dam, the question of the reservoir filling with silt, and some of the different remedies therefor. E. H. Baldwin, construction engineer of the dam, and now senior engineer and project manager of the Rio Grande project, made a short address covering the operations during construction.

The convention activities were reported to the Engineering Record by W. A. Perkins, of the U. S. Reclamation Service.

Scope of Washington City Planning Board Enlarged

City and County Planning Discussed at Everett (Wash.) Convention—Old Type Maintenance Clause Omitted

Among the many important features of the seventh annual convention of the League of Washington Municipalities and the state conference on city planning, held in Everett, Wash., Oct. 12, 13 and 14, was the enlargement of the scope of city planning into a county planning board to assist and co-operate with similar city organizations. This point had not been discussed at former conventions of the league. Twelve engineers representing Washington cities assembled at the convention. After deliberating upon the proposition of organizing as an engineers' association, they decided that the time is not ripe for a separate organization. Plans were made to continue as a factor of the municipality league.

D. W. McMorris, assistant city engineer of Seattle, presided. The engineers discussed paving and paving materials, maintenance contracts and other road problems. On the subject of the maintenance clause in road contracts the opinion of the meeting was that the old type maintenance clause should be eliminated and that chemical tests on ingredients and careful subsequent inspection during laying periods be substituted.

Standard Traffic Laws Recommended

Among resolutions endorsed by the league at the final meeting were: To add a section known as the building-construction, housing and fire hazard; to ask the legislature to pass a law permitting cities to build stockades on municipally owned property outside corporation limits where prisoners may be worked; endorsed and recommended as a law the regulation of water supplies and sewage under state board control; recommended drafting standard traffic laws for cities, which matter was placed in the hands of a special committee for framing.

Officers of the league serve two-year terms and are as follows: President, Leonard O. Meigs, North Yakima; vice-president, W. H. L. Ford, Everett, and secretary-treasurer, Dr. Herman A. Brauer, University of Washington.

Structural Mechanics Course Offered

Requests from a number of graduate engineers practising in Seattle have led the University of Washington to offer an evening course in advanced structural mechanics, beginning Oct. 17. Charles C. More, professor of civil engineering, will conduct the course.

Engineering Society Activities

The Philadelphia Association of Members of the American Society of Civil Engineers elected the following officers at the Oct. 2 meeting: President, Samuel T. Wagner; vice-president, Edgar Marburg; directors, Harrison Souder and Frederick E. Schall; secretary, C. W. Thorn. W. L. Stevenson was elected director to fill the unexpired term of Col. George A. Zinn, resigned.

The Engineers Society of Western Pennsylvania held a special meeting, Oct. 25 in Pittsburgh at which engineering phases of smoke abatement were discussed by Osborn Monnett.

The Albany Society of Civil Engineers met Oct. 24. The program for the evening consisted of a symposium on concrete on the general subject of present-day concrete practices or safety first in concrete, under the leadership of R. S. Greenman.

The Canadian Society of Civil Engineers will hold its next monthly meeting Nov. 2 in the rooms of the society in Montreal.

The Oregon Society of Engineers, at its Oct. 20 meeting, heard Frank F. Sinks describe the manufacture of steel on the Pacific Coast.

The Municipal Engineers of the City of New York met Oct. 25. The Moodna supplementary shaft and tunnel was described by George J. F. Carey, assistant engineer, Board of Water Supply, New York City. The engineers will hold their fourteenth annual dinner Nov. 25 at the Hotel McAlpin.

The Harvard Engineering Society of New York will meet Nov. 2, in the Harvard Club, New York City. A. A. Cohill, chief engineer for Patrick MacGovern & Co., will give an illustrated lecture on the Dorchester tunnels recently completed in Boston by the shield method under compressed air.

The Western Society of Engineers was addressed Oct. 16 by Harrison P. Eddy, consulting engineer, of Boston, on "A Comparison of the Activated Sludge and the Imhoff Tank-Trickling Filter Processes of Sewage Treatment."

What Engineers and Contractors Are Doing

Louis C. Kelsey, consulting engineer, of Portland, Ore., has been engaged by the city of Twin Falls, Idaho, to direct the construction of a water supply and the improvement of the distributing system. About $300,000 will be expected. Surveys have already been started.

Charles Gilman Hyde, professor of sanitary engineering at the University of California, has been appointed acting dean of the college of engineering during the absence of Charles Derleth, Jr. Professor Hyde has been a member of the faculty of the University of California since 1905, previous to which he was assistant engineer in charge of the improved waterworks at Harrisburg, Pa. Since his association with the university he has been connected with many California water projects in a consulting capacity.

Clark R. Mandigo has resigned as assistant city engineer of Kansas City, Mo., to join the engineering staff of the office of the Portland Cement Association in that city. Mr. Mandigo was graduated from Harvard University in 1907, following which he entered the service of the engineering department of the Northern Pacific Railway. The following year he became civil engineer and superintendent of construction in the U. S. Army. He served in the quartermaster's department until 1911, when he was made assistant city engineer of Kansas City, Mo.

O. L. Davis has left the employ of the bridge department of the Chicago, Burlington & Quincy Railroad lines west of the Missouri River to become designing engineer with the Concrete Engineering Company. He will have headquarters at Omaha, Neb.

Allen F. Sherzer, who was recently engaged by the British America Nickel Corporation, Limited, to work on the hydroelectric project at Wahnapitae, Ontario, has resigned to take a position with the Union Carbide Company, of Niagara Falls, N. Y.

Myron E. Fuller, for the last two years resident engineer for George W. Fuller, of New York City, in charge of the recently completed Plainfield-Dunellen, N. J., joint sewage-disposal project, has been appointed to a position in the bureau of surveys of Philadelphia. The sewage-disposal division, with which Mr. Fuller will be associated, is preparing plans for several large modern disposal plants for the city districts.

Guy Bonney, who resigned from the water department of Baltimore, Md., last year, and who has since been engaged on construction work in New Jersey, has joined the engineering department of the Bethlehem Steel Company at Sparrows Point.

A. W. Fuchs was recently appointed assistant sanitary engineer with the U. S. Public Health Service. His duties are in connection with the construction and operation of experimental trade waste disposal plants. After graduation from Cornell University in 1913, Mr. Fuchs joined the Baltimore Sewerage Commission, where he was employed until early in this year. Since last March he has been in the bridge department of the Lehigh Valley Railroad at South Bethlehem, Pa., and on New York Barge Canal work.

M. A. H. Scull has been transferred from the New York division of the Philadelphia & Reading Railway, where he was assistant supervisor, to the valuation department of that road. As assistant engineer in the latter department Mr. Scull will have charge of bridges and buildings. Since graduation from the civil engineering department of the University of Pennsylvania in 1912 he has been in the service of the Reading.

E. W. Dahl, of the U. S. Reclamation Service, was recently appointed county engineer of Yuma County, Arizona.

H. S. Harding has resigned from his position in the office of the estimating engineer, commissioner of accounts, New York City, to become assistant to the contract manager of the Turner Construction Company. Mr. Harding had occupied his recent position since 1914. Before that he was with the Board of Water Supply of New York City for seven years.

T. McLean Jasper, captain 172d Brigade, Royal Field Artillery, formerly assistant engineer with Alvord & Burdick, Chicago, writes that he is at Treviddo, Liskeard, Cornwall, England, recovering from his second wound, but expects to return to the continent about Jan. 1. In addition to his description of trench fighting he states that he was in charge of a squad of engineers making surveys for the location of gun foundations. Another detail was to pick up German shells, an increasing number of which, he says, do not explode.

R. R. Clark, structural engineer of Portland, Ore., has been appointed by the state highway engineering department to supervise the erection of steel work on all bridges in the state of Oregon which come within the jurisdiction of state officials. He is now completing a further report on the collapse of a reinforced-concrete bridge at McMinnville. A detailed report will be available shortly.

William Meadowcroft, for the last ten years assistant engineer with the Board of Water Supply of New York City and formerly connected with the engineering service of the Philippine Islands and the Metropolitan Water Board of Massachusetts, has volunteered for field service with the American Ambulance in France. Mr. Meadowcroft sailed for Paris Oct. 14.

Clyde Potts, consulting engineer, of New York City, has been retained to design outlet trunk sewers and sewage-disposal works for the city of Carbondale, Pa.

A. E. Chandler, of the California Water Commission, is in Honolulu, where he will assist the Hawaiian Water Commission in preparing the new water code for the Hawaiian Islands.

W. S. Lindsay, commissioner of Clark County at Vancouver, Wash., has been selected by the Interstate Bridge Commission temporarily as general superintendent of the interstate bridge across the Columbia River between Vancouver and Portland.

Arthur E. Loder, division engineer of the California highway commission, has been appointed assistant chief engineer of the U. S. Office of Public Roads and Rural Engineering. He will take up his new duties in Washington on Nov. 1. His office will administer the expenditure of the recent federal appropriation of $85,000,000 of which $75,000,000 is to be used in road construction in states where state funds of equal amount are raised. The $10,000,000 is to be used for road construction in the National Forests. This is to be undertaken in addition to the work now devolving upon the office of Public Roads and Rural Engineering. Mr. Loder was graduated from Purdue University in 1904. From then until 1907 he was assistant engineer in the U. S. office of public roads. In this position he was engaged in location and construction of roads that came under federal supervision. His work included a survey and investigation for a road and trail system in the Teton Forest Reserve in Wyoming. In August, 1907, he was made chief engineer of the Los Angeles County highway commission, in which capacity he laid out the road system constructed under a $3,500,000 bond issue. This work involved about 300 miles of highway and included the elimination of the notorious Fremont Pass grade, which was replaced by a route using a 435-ft. highway tunnel. After about 200 miles of the system had been built, Mr. Loder resigned in 1911 to engage in private practice in Los Angeles. Since 1912 he has been in charge of the state highway work in division IV, which centers at San Francisco. About 300 miles of road were planned in that division as part of the state highway system. Of this total 200 miles, including some of the heaviest construction in the system, have been located and constructed under Mr. Loder's supervision.

Frank A. Nikirk has been named temporarily as assistant city engineer of San Jose to fill a vacancy made by the resignation of J. W. Ford. The permanent appointment is to be made after a civil service examination has been held.

L. G. Burrell has resigned as assistant engineer for the Farris Bridge Company of Charleston, W. Va., to become bridge engineer of Wyoming County, in the same state.

Cleveland A. James, formerly resident engineer at Buffalo for the Lehigh Valley Railroad, in charge of terminal construction in that city, has opened consulting offices in the Fidelity Trust Building, Buffalo. After two years with the Cambria Steel Company he joined the engineering corps of the Pennsylvania Railroad. He resigned in 1905 to go to the Pensacola, Alabama & Western Railroad. Later in the same year he returned to the Pennsylvania. Mr. James was employed alternately by that road and the Tidewater Railway during the following three years, finally joining Delaware, Lackawanna & Western Railroad engineering department in 1908. At the time of his resignation in 1910 to go to the Lehigh Valley he had risen to the position of assistant engineer. His first work with that road was on the construction of the Hays Creek branch. Since February, 1914, he has been in charge of the terminal improvement at Buffalo and work on the western end of the road.

Señor Estaban Duqne Estrada, engineer of Havana, Cuba, is making a tour of the United States studying the design and operation of garbage-disposal plants.

M. F. Stein, formerly assistant engineer of design in the filtration department of Cleveland, has been made assistant engineer with Hering & Gregory, consulting engineers, of New York City. Mr. Stein was with the Cleveland engineering department for three years, previous to which he was associated with Chester & Fleming, consulting engineers, of Pittsburgh, for four years. Mr. Stein has devoted most of his time to a study of waterworks and water purification.

Louis L. Tribus, of Tribus & Massa, consulting engineers, New York City, has been retained as special engineering advisor to Mount Vernon, New York. That city is actively considering the municipalizing of its water system, one feature of which would be the acquisition of the essential portions of the plant of the New York-Inter-Urban Water Company, now furnishing its supply. George W. Fuller and James A. Harding have been appointed voting members in a conference board, to meet with J. W. Ledoux and Allen Hazen, who will represent the water company. If these four can not agree as to values a fifth engineer will be selected. The final reports, however, will not be binding on either city or company, but will undoubtedly have great weight in the subsequent negotiations or proceedings.

Obituary Notes

Lieut. Carl J. Beatty, Royal Flying Corps of the British Army, was recently killed in action. He left the employ of the engineering department of the British Columbia provincial government to enlist. From 1907 to 1911 Lieutenant Beatty had been a member of the engineer corps of the Northern Pacific Railway, rising to the position of assistant engineer at the time of his resignation to go to Canada.

Lewis H. Booker, a member of the contracting firm of Booker & Campbell, Bellingham, Wash., was killed Oct. 16 when the walls of a dry kiln at the Earles-Cleary Lumber Company's plant, being razed, collapsed and buried him beneath the brick and mortar.

J. Howard Jackson, of the firm of Jackson & Co., civil engineers, of Brantford, Ontario, died recently in that city. He was born in England and had spent many years in New Zealand in charge of engineering and surveying projects before coming to Canada. He was 59 years old.

James Sheppard, of Queenston, Ontario, superintendent of the Welland County good roads system, was killed recently at Brookfield by an express train. He had been in charge of the Welland County road work since its inception.

Leonard W. Rundlett of St. Paul, Minn., at one time city engineer of that municipality and a director of the American Society of Civil Engineers, is dead. Mr. Rundlett was connected with the city engineering department of St. Paul for about twenty-five years, according to available records. His duties as city engineer ceased in March, 1911, when a new administration came into power. Early in 1912, when Moose Jaw, Canada, was contemplating extensive waterworks construction, Mr. Rundlett was made commissioner of public works of that city. He resigned in February, 1914, and returned to St. Paul.